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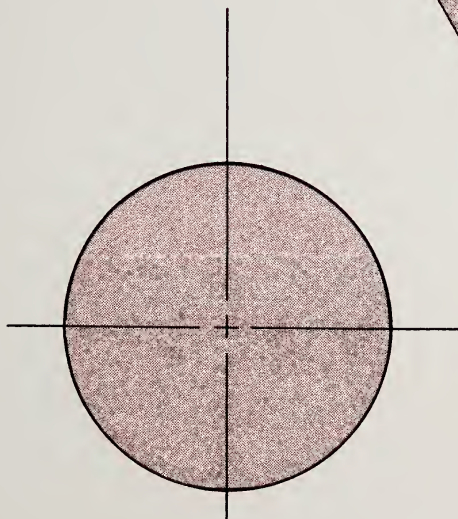
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INTRODUCTORY DRAFTING SI



ALBERTA DISTANCE LEARNING CENTRE
ALBERTA EDUCATION
BARRHEAD, ALBERTA

CANADIANA
OCT. 25 1991

Introductory Drafting



**Distance
Learning**

Alberta
EDUCATION

Introductory Drafting
Student Module
Lessons 1-4
Alberta Distance Learning Centre
ISBN No. 0-7741-0838-X

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**A LESSON RECORD FORM MUST BE COMPLETED FOR EVERY LESSON
SUBMITTED FOR CORRECTION, AS ILLUSTRATED BELOW**

A Lesson Record form with the **correct** label attached **must** be enclosed with **every** lesson submitted for correction, as illustrated below.

Correct use of these labels will ensure prompt processing and grading of your lessons.

The enclosed **Lesson Labels** must be checked for spelling and address details.

Please advise the Alberta Distance Learning Centre promptly of any changes in name, address, school, or any other details and we will issue a revised set of labels. Your file number is permanently assigned and **must** be included on all correspondence with the Alberta Distance Learning Centre. If the proper label and Lesson Record Form is not attached to each lesson as indicated it will delay your lessons being processed and credited to you.


Lesson labels are to be attached to the **lesson record forms** in the space provided for student name and address.

Check carefully to ensure that the **subject name**, **module number** and **lesson number** on each label corresponds exactly with the lesson you are submitting.

Labels are to be **peeled off** waxed backing paper and **stuck** on the lesson record form.

Only **one** label is to be placed on each lesson.

LESSON RECORD FORM

FOR STUDENT USE ONLY		FOR A.D.L.C. USE ONLY	
Date Lesson Submitted _____	(If label is missing or incorrect) File Number _____ Lesson Number _____	Assigned Teacher: _____ Lesson Grading: _____ Additional Grading E/R/P Code: _____ Mark: _____ Graded by: _____ Assignment Code: _____ Date Lesson Received _____ Lesson Recorded _____	
<div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;"> <p align="center"><small>Student's Questions and Comments</small></p> </div> <div style="border: 1px solid black; padding: 5px;"> <div style="display: flex; align-items: center;"> <div style="writing-mode: vertical-rl; transform: rotate(180deg); font-size: small; margin-right: 5px;">LESSON</div> <div style="writing-mode: vertical-rl; transform: rotate(180deg); font-size: small; margin-right: 5px;">MODULE</div> <div style="writing-mode: vertical-rl; transform: rotate(180deg); font-size: small; margin-right: 5px;">FILE NUMBER</div> <div style="writing-mode: vertical-rl; transform: rotate(180deg); font-size: small; margin-right: 5px;">COURSE NAME</div> <div style="text-align: center;">  </div> <div style="writing-mode: vertical-rl; transform: rotate(180deg); font-size: small; margin-left: 5px;">Name</div> <div style="writing-mode: vertical-rl; transform: rotate(180deg); font-size: small; margin-left: 5px;">Address</div> </div> </div>		<p style="font-size: x-small; margin-top: 20px;">Please verify that printed label is for correct course and lesson</p>	
<div style="border: 1px solid black; padding: 5px; min-height: 100px;"> <p align="center"><small>Teacher's Comments</small></p> </div>		<p align="right">Student name and Address</p>	
<p><small>St. Serv. 14-81</small></p>		<p align="right"><small>Correspondence Teacher</small></p>	

DO NOT MARK OR COVER BAR CODING.

CHANGE OF ADDRESS

If the address on your lesson record form differs from the address you supplied on your registration application, please explain. Indicate whether the different address is your home, school, temporary or permanent change of address.

When revised labels are received, place the correct new labels on your Lesson Record Forms.

THE HISTORY OF THE UNITED STATES

The history of the United States is a story of growth, struggle, and achievement. From the first European settlements to the present day, the nation has evolved through a series of challenges and triumphs. The early years were marked by the struggle for independence from British rule, a struggle that culminated in the signing of the Declaration of Independence in 1776. The new nation then faced the task of building a government that could unite the diverse peoples of the continent. This led to the adoption of the Constitution in 1787, which established the framework for the federal government and the rights of the states.

The 19th century was a period of rapid expansion and change. The westward movement of settlers led to the discovery of gold in California and the opening of the transcontinental railroads. At the same time, the nation was divided by the issue of slavery, which ultimately led to the Civil War in 1861. The war was a turning point in American history, as it resulted in the abolition of slavery and the strengthening of the federal government. The Reconstruction period that followed was a time of great struggle and progress, as the nation sought to rebuild and reunite itself.

The 20th century has been a period of unprecedented growth and change. The United States emerged as a world superpower after World War II, and its influence has been felt around the globe. The nation has also faced significant challenges, including the Great Depression, the Vietnam War, and the civil rights movement. Despite these challenges, the United States has remained a beacon of hope and freedom, and its history continues to inspire and guide the people of the world.

Introduction

This is an introductory drafting module which teaches basic skills in drafting. All instructional material is contained in this module. The contents of this module are as follows.

Lesson	Title
1	Sketching and Lettering
2	Using the Drawing Instruments, Dimensioning
3	Drafting Lines and Working Drawings
4	Pictorial drawings

For this module, the student must have:

- *1 Drawing board, preferably 450 mm by 600 mm
- 1 T-square
- 1 30° - 60° triangle
- 1 45° triangle
- 1 Ruler in millimetres
- 1 Pencil eraser — a good, soft, pink eraser
- 2 Pencils, one of these H and the other 4H
- 1 Small piece of fairly fine sandpaper for sharpening pencil lead
- 1 Clean cloth or draftsman's erasing brush
- 1 Roll drafting tape
- (The white plates for the exercises are at the back of this course.)

You may use the enclosed form to purchase any of these items if you wish.

*If you do not plan to continue with drafting after this module, it may not be worth the trouble or expense to obtain a drawing board. A smooth and square table top or desk top should be suitable.

Drafting

Do your lesson work as follows. Read the lesson material contained in each lesson. Complete each exercise in the space provided. Then take your drawing board and drafting instruments and do the drawing problems on the paper provided with each lesson. RETURN to the Alberta Distance Learning Centre all sheets of completed exercises, and all drawings in the lesson. Fill out the LESSON RECORD FORM making sure you do so completely, and use the reverse side as a mailing cover for your exercises and drawings.

Upon completion of the course you will be required to write a final test. Be sure to bring to the examination room the following:

- Drawing board (or have a smooth desk)
- T-square
- 4H pencil
- sandpaper for sharpening pencils
- soft eraser
- duster or brush
- ruler in millimetres
- 30° - 60° triangle
- 45° - triangle
- drafting tape

Supplies

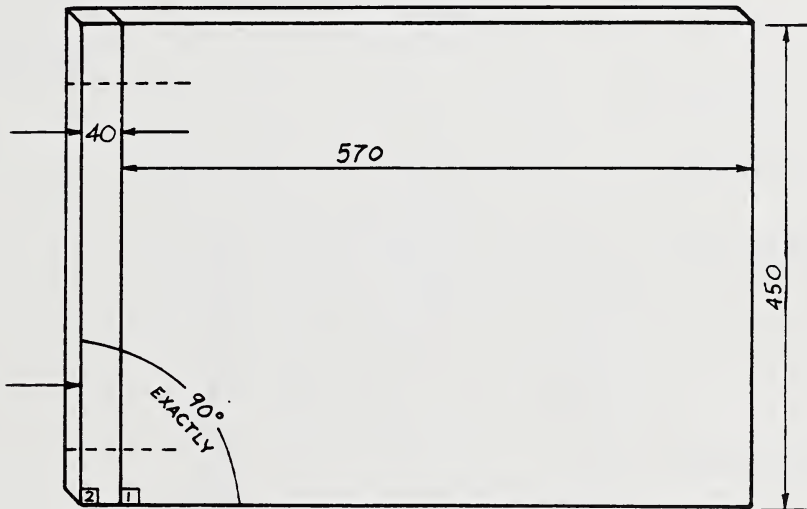
Enclosed is an order form which you may use to obtain some drafting supplies. Note that you do not have to order the items indicated from the company named. However, you should obtain the items listed on page - i - from your chosen source of supplies as soon as possible in order to begin work without excessive delay.

INSTRUCTIONS FOR MAKING A DRAWING BOARD

Since a professional drawing board is relatively expensive, drafting students may make their own drawing board for use in this course if they so desire. Plans for an inexpensive board are given below.

Materials Needed: (Purchase locally.)

1. Plywood - 5 ply, about 20 mm thick, 450 mm \times 570 mm
2. Clear Spruce or boxwood or basswood 40 mm \times 20 mm \times 450 mm
3. Finishing nails 60 mm, glue, sandpaper



Saw and plane angles 1 and 2 to 90° exactly (use a good square) then glue and nail the slide strip on the left after the strip has been planed to size and has straight edges. Set in the heads of the finishing nails at least 3 mm before beginning to plane the edge square and smooth after gluing.

Use fine sandpaper, with the grain, to smooth the surface, then rub well in with the fingers one only very light coat of boiled linseed oil. Let it dry two or three days before using.

(Do not plane into the nail heads. Set in the nails first.)



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LESSON RECORD FORM
Introductory Drafting SI

FOR STUDENT USE ONLY	
Date Lesson Submitted _____	(If label is missing or incorrect) File Number _____ Lesson Number _____
Time Spent on Lesson _____	

Student's Questions and Comments

Apply Lesson Label Here

Name _____
Address _____ _____ _____
Postal Code _____

*Please verify that preprinted label is for
correct course and lesson.*

FOR SCHOOL USE ONLY
Assigned Teacher: _____
Lesson Grading: _____
Additional Grading E/R/P Code: _____
Mark: _____
Graded by: _____
Assignment Code: _____
Date Lesson Received: _____
Lesson Recorded _____

Teacher's Comments:
_____ Correspondence Teacher

ALBERTA DISTANCE LEARNING CENTRE

MAILING INSTRUCTIONS FOR CORRESPONDENCE LESSONS

1. BEFORE MAILING YOUR LESSONS, PLEASE SEE THAT:

- (1) All pages are numbered and in order, and no paper clips or staples are used.
- (2) All exercises are completed. If not, explain why.
- (3) Your work has been re-read to ensure accuracy in spelling and lesson details.
- (4) The Lesson Record Form is filled out and the correct lesson label is attached.
- (5) This mailing sheet is placed on the lesson.

2. POSTAGE REGULATIONS

Do not enclose letters with lessons.

Send all letters in a separate envelope.

3. POSTAGE RATES

First Class

Take your lesson to the Post Office and have it weighed. Attach sufficient postage and a green first-class sticker to the front of the envelope, and seal the envelope. Correspondence lessons will travel faster if first-class postage is used.

Try to mail each lesson as soon as it has been completed.

When you register for correspondence courses, you are expected to send lessons for correction regularly. Avoid sending more than two or three lessons in one subject at the same time.

Sketching and LetteringDrawing Pencil

All drawing in drafting is first done with a pencil. Later you may learn to ink your drawings, but even an ink drawing is always drawn first in pencil. In this course all work is to be done in pencil, and ink drawings will not be accepted under any circumstances.

It is also important that only pencils with hard lead be used. Never do work in this course with a pencil whose lead is graded softer than H.

A capital letter appears at one end of every pencil. This letter indicates the blackness of the lead. Soft leads give a very black line with little pressure put on the pencil, while hard leads yield a grayer line. The letters indicate the range of hardness like this:

B - soft
F - medium soft
HB - medium
H - hard

Grades of 2B, 3B, 4B, up to 6B are progressively softer than B. Grades of 2H, 3H, 4H, up to 9H are progressively harder than H. Soft pencils are used by artists, not by draftsmen.

In this course you are to use pencils of two grades only: H and 4H. These pencils are readily available in the stores in Alberta. If your local store does not have them in stock ask the storekeeper to order some for you. Successful drafting can be done only with hard pencils.

DO ALL WORK IN THIS COURSE WITH 4H AND H PENCILS.
--

Do the preliminary work on all your drawings with the 4H pencil. We shall require mainly two weights of lines:

Light lines -- these are drawn with the 4H pencil

Heavy lines -- these are ALSO drawn with the 4H pencil and then gone over or heavied up with the H pencil.

In other words, for our purposes the 4H pencil is our hard pencil, and the H pencil is our soft pencil.

Sharpening the Pencil

Sharpen the pencil at the end opposite the lettering so that the grade letter is not cut off as the pencil wears down.

The difference between the drawing work done by the layman and that done by the professional draftsman depends to a great extent on using exact procedures which meet the needs of this type of work. Most of these are easy to learn but are also easily overlooked. The procedure used for sharpening pencils is a typical example. A pencil sharpener is not used because it does not produce a good tip for drawing lines with. Instead, the wood is trimmed off the pencil end with a pocket knife until 6 mm or more of lead is exposed. Do not cut the lead or scrape it with the knife. To sharpen the lead to a conical point rub it on a fine-sandpaper block, rolling the pencil between fingers and thumb while doing so. Do not keep the pencil sharpening equipment near the drawing board or instruments since this will result in graphite smears on your drawings. Blow on the pencil tip after sharpening, to remove graphite particles, and wash your hands before touching the drafting paper.



Fig. 1-1. Trim the pencil so that 6 mm or more of lead is exposed.

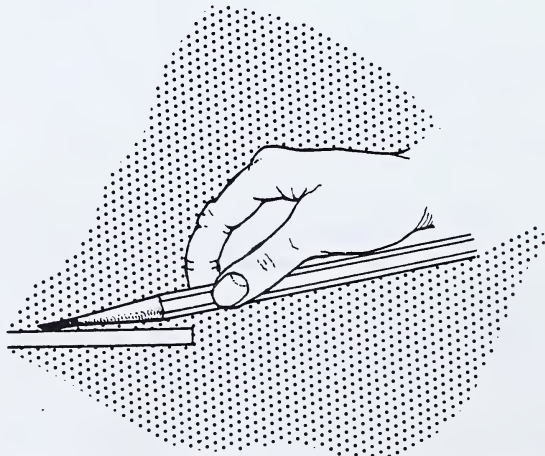


Fig. 1-2. Roll and sharpen the point on the sandpaper pad.



Fig. 1-3. Conical point on 4H pencil.

Exercise 1: Selecting and Sharpening a Drawing Pencil

(In 1, 2, and 3, answer "True" or "False".)

1. The pencil should not be sharpened on the lettered end because the letter helps in selecting the proper pencil after all the pencils have been sharpened. _____
2. If one cuts the lead with a knife, the lead, being brittle, is quite likely to break. _____
3. A fine grade of sandpaper should be used for sharpening. _____
4. Why should you sharpen the pencil away from your drawing?

5. Soft pencils are lettered with _____ and a number and hard pencils are lettered with _____ and a number on the end.

(Fill in each blank with the correct letter.)

6. Pencils used in drafting are _____ and those used by artists are _____.

(Fill in the blanks.)

Erasing

A good pencil eraser is always soft and pliable. Any pencil eraser will do provided it is fresh. The rubber dries out with age and the eraser must be replaced if it becomes stiff. An art-gum eraser is useful for erasing over a wide area, but is not essential for this course. NEVER use an ink eraser. It will destroy the surface of the paper.

In ordinary work one often blows off the particles left after erasing or even brushes them aside with the hand. Here again, correct technique makes the difference between layman and draftsman. NEVER rub your drawing paper with your hand or sleeve. This introduces dirt or grease on to the paper. ALWAYS use a clean rag or, best of all, a soft brush. (Special brushes are made for drafting.)

Check list of erasing procedures

1. Draw all lines lightly until you are certain your work is correct.
2. Remove all instruments from the board before erasing.
3. Clean the eraser before using it, by rubbing it on a piece of scrap paper.
4. Hold the thumb and forefinger of one hand in such position, near the area to be erased, that the drawing will not be torn or wrinkled while erasing with the other.
5. With a dust brush, sweep the whole drawing board free of all particles.

Exercise 2: Erasing

(Answer "True" or "False".)

1. If the hand is used instead of a cloth or brush for wiping away particles left from erasing, the paper will become dirty due to grease and moisture on the skin. _____
2. An ink eraser will destroy the smooth surface of the paper even though it erases the line quickly. _____

Sketching Straight Lines

Before one can make an accurate drawing a sketch is necessary. It is much quicker and more convenient to sketch freehand than to use instruments for drawing straight lines and circles. However a sketch which does not show straight edges with reasonably straight lines is of little use. To sketch good straight lines hold the pencil lightly about 50 mm from the point. Make a mental note of where you want to stop your line before you begin to draw. Then run your hand along carrying the pencil in a single fairly fast relaxed movement along the paper to this point. Avoid lifting the pencil from the paper before you reach the end of the line. Draw each line with a SINGLE, clean stroke, not a succession of fuzzy strokes. To maintain the conical point on the pencil, occasionally rotate the pencil in your fingers as you sketch.

Check list of sketching procedures

1. See that the pencil is kept sharpened to a long, cone-shaped point.
2. Hold the pencil lightly, 50 mm or more from the point.
3. Lightly locate the points between which the straight line is to be drawn. Start at one point and keep the eye on the other. Then draw the hand steadily across the paper. If the line is wavy erase it and redraw it.
4. Use the eraser as little as possible. Try to get the line right the first time.
5. Sketch horizontal lines from left to right; vertical lines from the top downward. Usually lines at a slant are also sketched from the top downward.
6. Rotate the pencil in your fingers as you sketch.

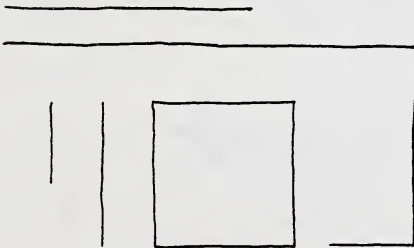


Fig. 1-4. Sketched lines should meet squarely.

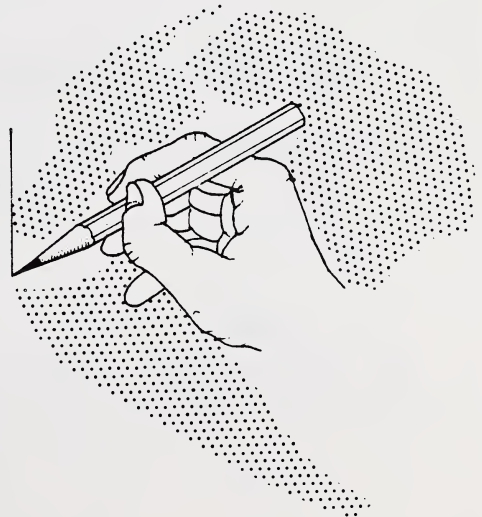


Fig. 1-5. Sketch vertical lines from the top downward.

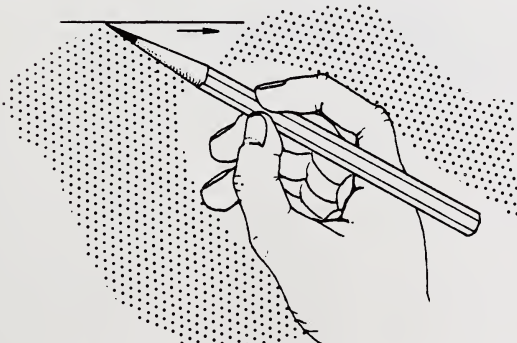


Fig. 1-6. Sketch horizontal lines from left to right.

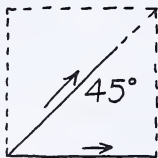
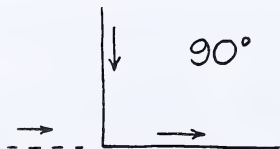
Exercise 3A: Sketching Straight Lines

In the space below, with an H pencil draw six examples of

(a) horizontal lines, (b) vertical lines, (c) squares, (d)  shapes.

Sketching Angles

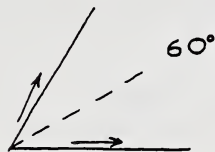
An angle of 90° with the horizontal is easy to sketch. Just draw a down stroke followed by a stroke to one side or the other.



Draw a 45° angle by mentally considering a square. The diagonal makes a 45° angle with either side.



To draw a 30° angle estimate $\frac{2}{3}$ of a 45° angle.

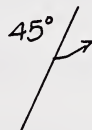
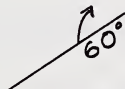
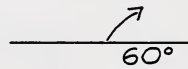
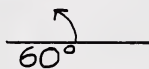
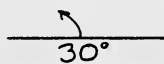
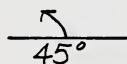
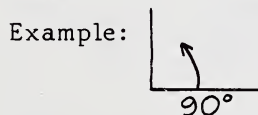


If you practice 30° angles, you can make a 60° angle by estimating double the size of the 30° angle.

Note directions of pencil strokes, shown by arrows.

Exercise 3B: Sketching Angles

- In the space below complete a sketch of each angle ABOVE the arm already drawn as indicated by the arrow. Estimate the size of the angle. Do not use any instruments to measure with.



- Below each heading sketch at least three angles of approximately the size called for in the heading. Make some of the angles so that neither side is horizontal nor vertical. Do not use any measuring instruments.

30°

45°

60°

90°

Lines used in Drafting

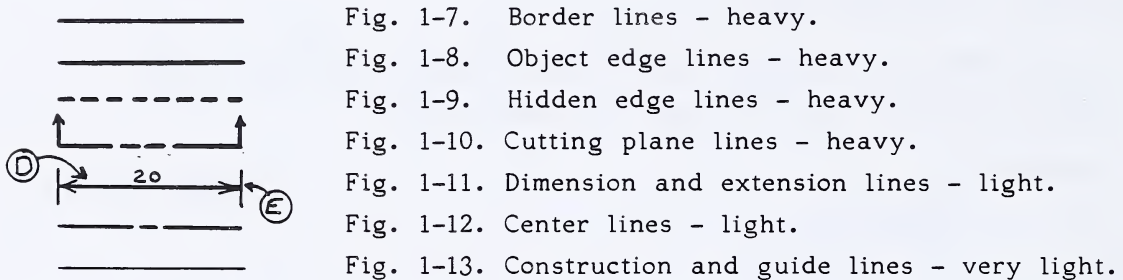
We shall use three weights of line in this course:

Light lines - drawn with the 4H pencil.

Heavy lines - these are also drawn with the 4H pencil but afterwards they are heavied up by going over them with the H pencil with a firm but NOT too heavy pressure.

CAUTION: Heavy lines should never be thick lines. Any dense, black, thick line will smear the paper.

Construction and guide lines - these are drawn with the 4H pencil as lightly as possible. They are not intended to show on the finished drawing so they are drawn so lightly they will just be visible to the draftsman, and they will not have to be erased. If a drawing is later gone over in ink these lines are not inked in. After inking they are erased. But on pencil drawings they are NOT erased.

Check list of types of lines and how to draw them

1. Border lines. Lay them out with a 4H pencil. Heavy up with the H pencil.
2. Object edge lines. These are drawn in the same way as border lines.
3. Hidden edge lines. Use 4H pencil and then heavy up with the H pencil. The dashes should be about 3 mm separated by 2 mm spaces. This spacing may be judged by eye. How these lines are used will be discussed later in the lesson.
4. Cutting plane lines. The long dashes are 20 to 40 mm long and the two short dashes between each long one, are each 3 mm long separated by 1 mm spaces. What these lines are used for will be discussed later. Draw with 4H pencil and heavy up with H pencil.
5. Dimension lines are light lines made with a 4H pencil. (See D in Fig. 1-11.)

Note that guide lines (and construction lines) shown in this course appear heavier than they should be when drawn with a pencil. This was done so that they would be printed more easily.

6. Extension lines are light lines made with a 4H pencil. They are short lines which tell to which part of the object the dimension refers. They lead from a point about 1 mm from the view and extend about 2 mm beyond the arrowhead. An extension line is shown at E in Fig. 1-11.
7. Center lines are light lines made with a 4H pencil. The long dashes should be of uniform length, 20 to 40 mm long, and the short dashes should be 3 mm long. The spaces between the long and short dashes should be 2 mm. These lengths may be varied to the size of the drawing. Center lines are used to locate the centers of circles and the axes of symmetrical parts.
8. Construction and guide lines. These are made as light as possible by using hardly any pressure on the 4H pencil. The uses of construction lines will be shown later in the lesson. Guide lines are used for lettering. These lines should be invisible at arm's length.

Exercise 4: Conventional Lines of a Working Drawing

1. Match the names of the lines shown in Fig. 1-7 to Fig. 1-13 with the lines marked with letters in Fig. 1-14.

Example: V - Object edge line

B -

C -

D -

E -

F - Cross hatching

G -

H -

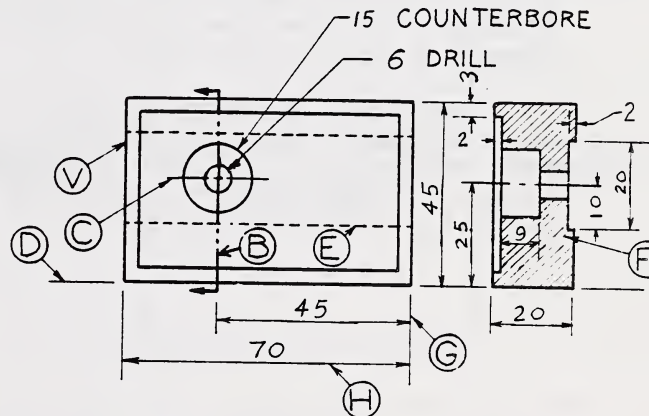


Fig. 1-14. Working drawing of a jig.

2. The line that shows where a measurement stops is a:
 - (1) section line, (2) parallel line, (3) extension line,
 - (4) visible outline, (5) heavy line. (Underline the correct words.)

Views of a Working Drawing - Orthographic Projection

When we look at a solid object we can not of course see all sides of it at once. Consider the simplest type of object, a rectangular block. If we turn the block slightly and place it below eye level the most we shall be able to see is one end, one side, and the top. Furthermore, the angles and lengths will not appear in their true sizes.

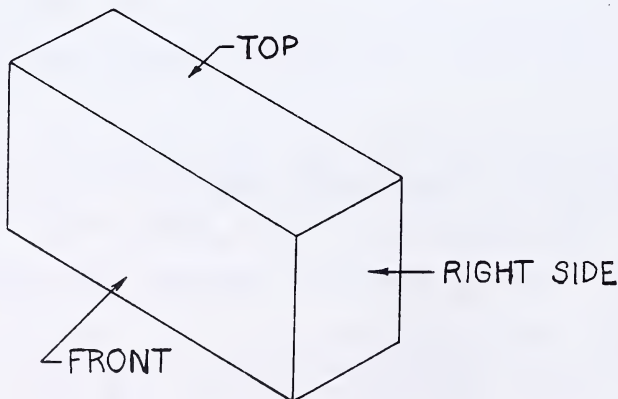
A pictorial drawing is a drawing which shows an object as it looks to the eye. Such a drawing is not suitable for use in supplying the information required to make an object. It is the draftsman's job to create from the object or a pictorial drawing of the object, a set of working drawings which will provide all the information required to enable the workman to construct the object.

The working drawing separates the object into faces. Each face is shown in its true shape and size. Also the faces are shown on the drawing in their correct relationship to one another. The method used to achieve this is called orthographic projection.

Using this method each view shows a face as it appears from a point directly in front of it. The front view is drawn as it appears when it is straight in front of the observer so that the line of sight between the surface observed and the eye is at right angles (perpendicular) to the surface. The top view is also drawn looking squarely at it from a point directly above. The side views likewise are drawn as if seen from points directly in front of the sides.

Consider the rectangular block. It has six sides or faces. So as to keep track of what we are talking about we shall give each face a name. The name we give to a particular face depends on the side of the block we choose to stand it on. To get the best picture we stand the block so that one of the largest faces is facing us. So we stand the block up like this:

Now the faces are named
as shown in the illustration.

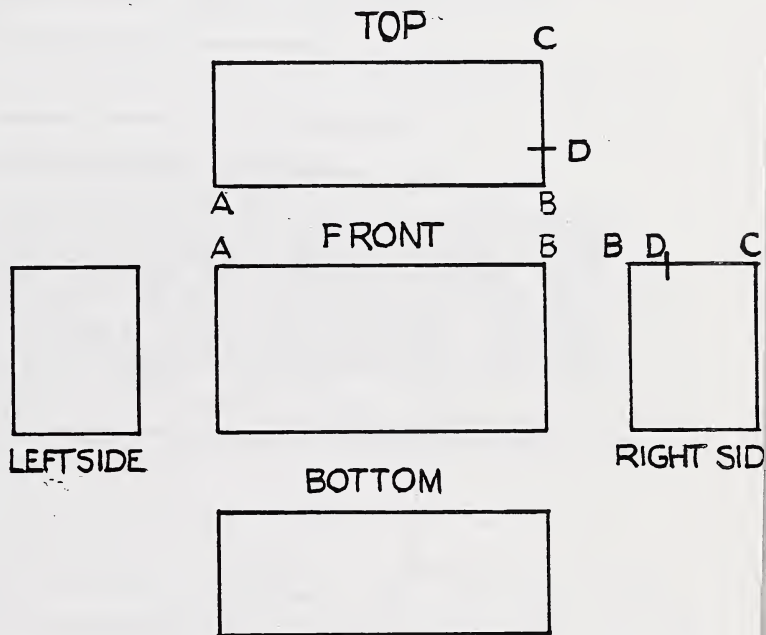


The block has six faces but we can see only three of them. The faces which are hidden are the back, the bottom, and the left side.

An orthographic drawing consists of a separate outline for each face. But it is not necessary to draw all six faces in order to portray all of the details of the object. Usually three faces are drawn, but sometimes two or even one is sufficient. The separate outlines are arranged in a special way. Suppose we were to draw the top, front, bottom and side views of the rectangular block. In the center we put the front view. In line with this on the right we put the right side view. Also in line on the left we put the left side view.

Still in line but vertically above the front view we put the top view. Likewise the bottom view is in line vertically below the front view.

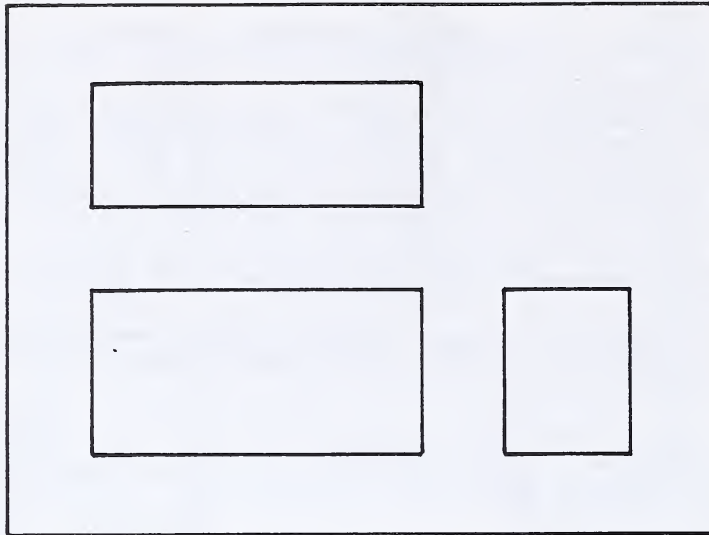
You must realize that each line in the drawing represents an edge of the block. There are however more lines in the drawing than there are edges of the block. This is because each edge is shown on two views. It is very important to understand which two lines represent the same edge and which end of any line in one view corresponds to the same end in the other view in which it appears. Thus in the drawing the edge AB in the front view is the same edge as AB in the top view. Also, if we have a point D on the right side view which is a quarter of the way from B to C, it will also appear at D in the top view, nearer to B than to C.



If we measure to the RIGHT on the side view we must measure UP on the top view.

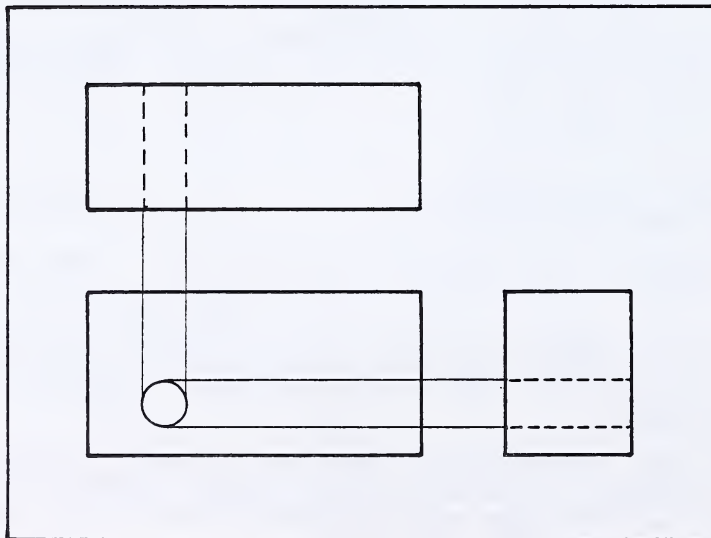
The corner B appears in three views in such a way that all points B are next to one another. Also each of the two lines which represent one edge are alongside each other in adjacent views. (Adjacent views are those next to each other.)

Now for most objects all six views are not needed since opposite faces are alike or nearly so. Usually, at most, three adjacent faces are sufficient. In this case the front, top, and right side views may be used, and they are placed on the drawing like this:



(The faces shown are NOT named on the working drawing. Which way up the finished object will rest is of no interest to the workman.)

Now suppose a fifteen millimetre hole was drilled through the front of the block. It would of course come out at the back. But it would not be possible to see the hole if the block were facing end on. Nor could you see the hole if looking at the top of the object. The draftsman must draw the views as if he had X-ray eyes and could see ALL edges below the surface of any face. These edges are drawn with hidden-edge lines and the orthographic drawing looks like this:



(Note how construction lines were used to assist in lining up the hidden-edge lines. When drawing board and instruments are used these might not be necessary.)

Exercise 5: Views for a Working Drawing

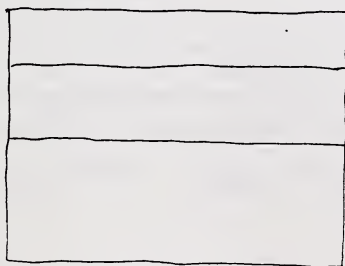
1. In a working drawing, the top view is placed exactly above the front view. _____
2. The right side view is placed in line with and to the right of the top view. _____
(In 1 and 2, answer "True" or "False".)
3. A photograph does not show the necessary _____
for making an object. (Fill in the blank.)
4. Why does a simple rectangular block require a working drawing with only two views? _____

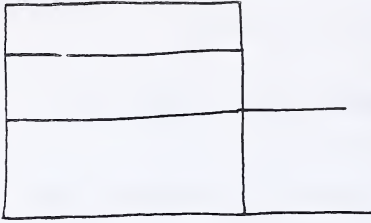
Sketching a Working Drawing (Orthographic Projection)

A free-hand sketch must first be made before any working drawing is made with instruments. The sketch must be complete. It must contain all the information which is required to be placed on the final drawing to enable the workman to construct the object. All the views which are required must be in the sketch and placed in correct relation to each other. Everything should be roughly in proportion or to scale. That is, if the length of a block is 100 mm and its width is 50 mm, the rectangle should appear to be twice as long as it is wide. But do not make any measurements—estimate the lengths in proportion to each other by eye.

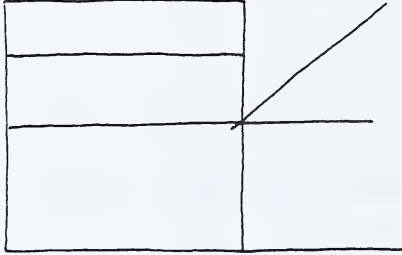
Working drawings are in orthographic projection. Projection is done by extending construction lines from one view to another. For example, let us consider a working drawing for a rectangular block which is 100 mm \times 50 mm \times 25 mm.

First we sketch the front view which will be the 100 \times 50 mm surface. It will be a rectangle about twice as long as wide. Now the top view will show a 100 \times 25 mm surface. To obtain the 100 mm length we simply extend the end lines upwards, then draw two more horizontal lines the right distance apart to represent 25 mm. Our drawing should now look like this:

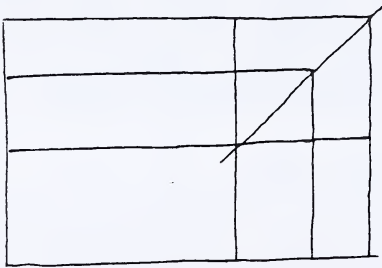
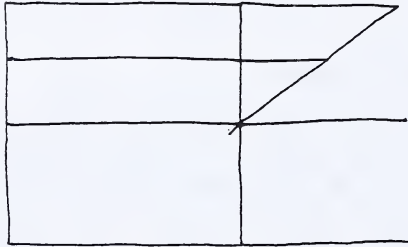




The right side view must now be added. The side of the block 50×25 mm rectangle. This rectangle is completed in the sketch simply by extending the lines we already have in the proper way. The 50 mm length is obtained by extending from the front view as shown:

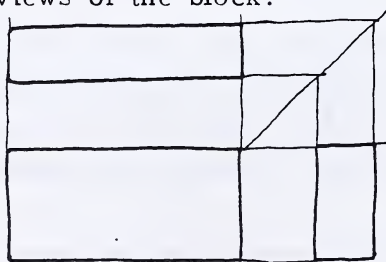


Now we draw a line at 45° from the top right corner of the front view as shown. Then we just extend ALL the horizontal lines in the top view to meet this line.



Finally we drop vertical lines down from each point where these lines meet the 45° line and our side view is complete.

If all the construction lines have been made very light we can now arrive at the sketch of the three views by heavying up the lines which actually show the three views of the block.



In problems as simple as this you will not need to use construction lines at all, or you can make them exceedingly light. But unless your sketches are designed with these projection lines in mind you may make errors in projection from one view to another.

Before the sketch is finished every dimension required by the workman must be placed on it. In a later lesson we shall discuss in detail how to do this. But for practice and so that you do not forget that the finished sketch requires dimensions you are to copy the examples of the sketches we shall show below, complete with all dimensions.

Enough space must be left between views to allow for the insertion of dimensions. The amount to leave will be discussed later. Make the sketches about the same size they appear here. Remember the dimensions do NOT refer to the size of the sketches at all. They indicate the sizes of the parts of the actual object. All we want is to have the lengths in proportion. Use 4H pencil for all preliminary sketching. Heavy up the object outlines (but not the dimension lines) with an H pencil. Do not make any measurements when sketching. Proportion the lengths by eye. A drawing made with all lengths in proportion is called a scale drawing, or a drawing drawn to scale.

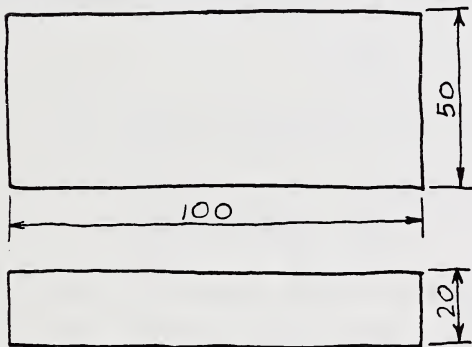
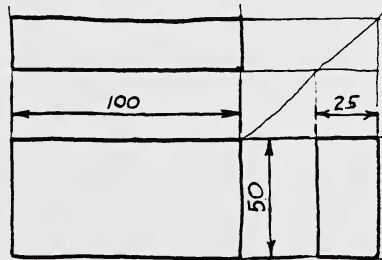


Fig. 1-15. Rectangular block

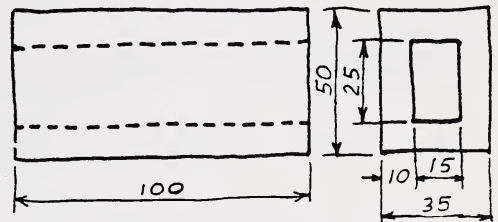


Fig. 1-16. Hollow block

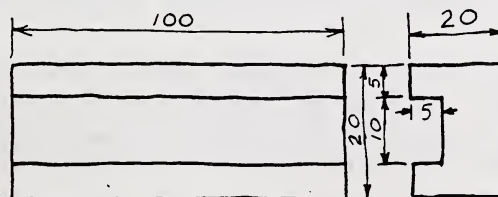


Fig. 1-17. Channel block

Exercise 6: Sketching a Working Drawing

In the space below make a sketch of a working drawing for each of the three objects on page 15: the Rectangular Block, the Hollow Block, and the Channel Block. Leave in the construction lines required to project the views shown.

Lettering

As well as dimension numbers, working drawings contain a considerable amount of words. These words include titles, scale indications, instructions on how to make holes and finish surfaces, etc. All lettering is done in the capital or upper case alphabet, A, B, C, D, E, etc. The lower case letters a, b, c, d, e, etc. are NEVER used.

A finished drawing is called a plate. Most of the lettering we shall use will be 3 mm high. But titles of the plates will be 5 mm high. However, to start out, we shall ask you to outline much larger letters to enable you to note the details of their form and proportions more closely.

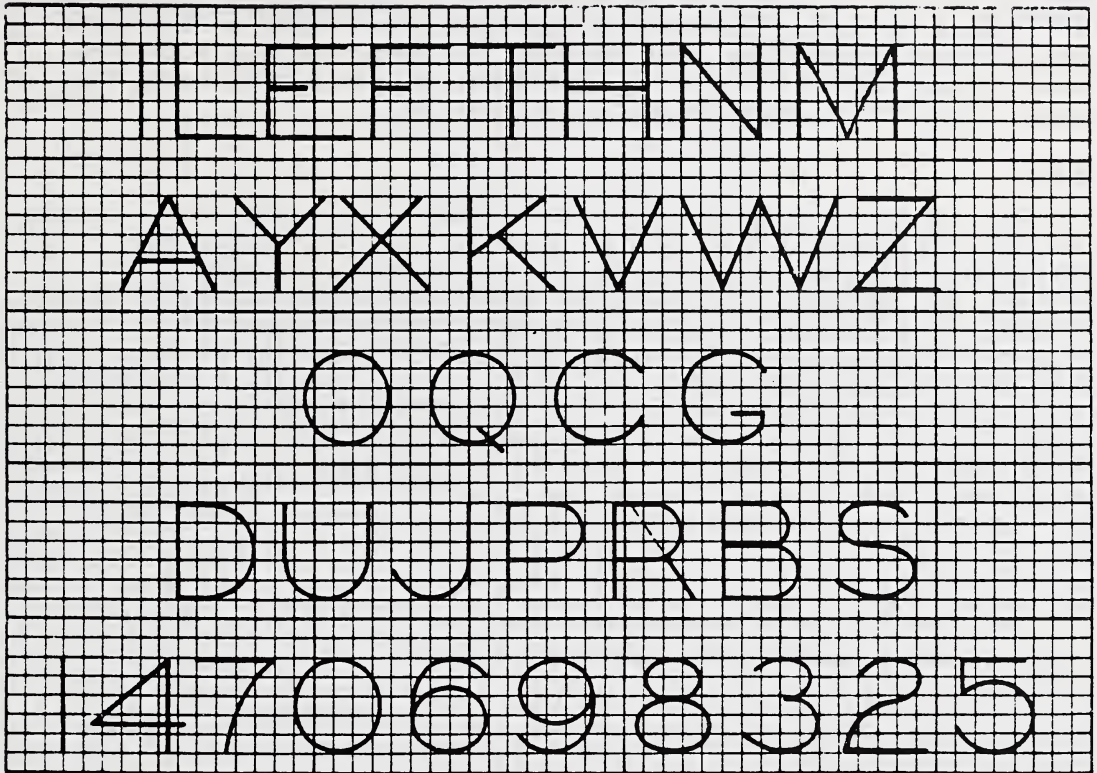


Fig. 1-18 Practice exercise

1. (a) The letters in the first row are made up mainly of horizontal and vertical strokes.
 (b) Most letters are four units wide, but the base of **E** is longer than the top; the top of **T** is $4\frac{1}{2}$ units; **H** is a little wider than 4 units; **M** is 5 units wide.
2. (a) The letters in the second row consist mainly of diagonal strokes.
 (b) **A** is 5 units wide; **X**, **K** and **Z** are wider at the base than at the top; **W** is 8 units wide.
3. The letters in the third row are made up mainly of curved strokes. These curves are ellipses, not circles, E.g. **O** is not a circle **○** but is higher than it is wide.
4. (a) The letters in the fourth row are a combination of straight strokes and curves.
 (b) Note that **R**, **B** and **S** are wider in the lower portion than the upper.
5. The numerals **8**, **3**, **2**, and **5** are wider in the lower portion than the upper.

The reason several of the characters are wider at the base is so that they will not look top heavy but give a feeling of stability.

Exercise 7: Copy Fig. 1-18 on the squared paper provided in this lesson. Be sure to draw all lines FREE HAND as instruments are never used in lettering except to draw guide lines. Note carefully the spacing of the width and height of each letter. See that the separation between letters is the same as shown in Fig. 1-18. Use an H pencil for lettering.

Numerals

Lettering in drafting refers to drawing both letters and numerals. All lettering in drafting is done by first drawing very light guide lines. A pair of these lines is used to line up the top and bottom of all letters and numerals. The shape of each character should be uniform each time it is repeated and there is a set style for forming each which we should like you to adopt. There are formal rules for making the strokes but you can probably arrive at your own system which will enable you to reproduce the desired style for each character. We shall now point out the main features of each character as you should draw it. To begin with, we shall show each numeral placed between guide lines 4 mm apart. Note that guide lines are VERY light. Use a 4H pencil for this. Do your lettering with an H pencil. Beside each example, draw a succession of copies of the numeral to fill out the line.

Exercise 8

Repeat each numeral between 5 and 10 times.

A single, dead upright stroke.



2 2

The upper portion is balanced over the base which is the widest portion.

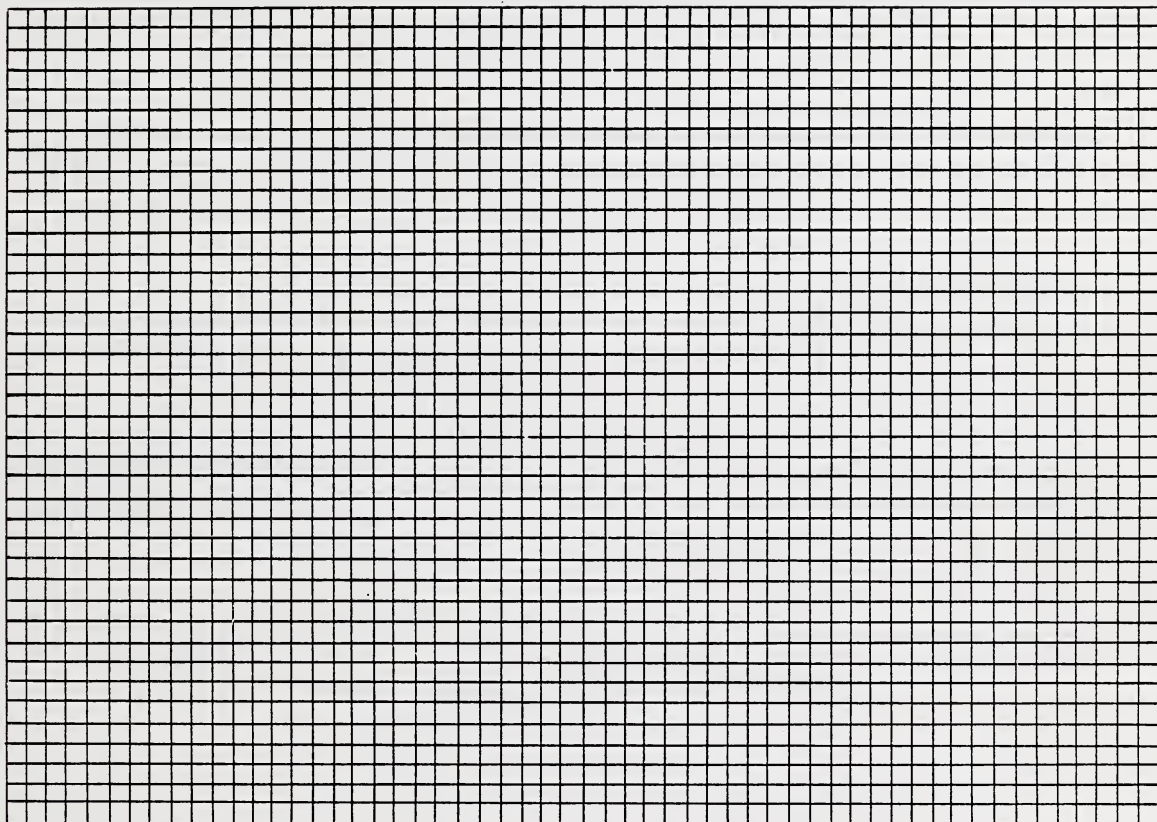
3

Lower loop larger than upper. Do not use the 3 style as this resembles 5 too closely.

4 4

Draw the 4 portion first, then add the | stroke. Keep the — stroke well below the middle height.

Squared Paper for Exercise 7



Draw the 5 first, then add the short bar at the top. Avoid 5 or 5 or 5 .

Note the 3 strokes, reverse direction with each stroke. Avoid 6 .

Avoid 7 .

Draw two ellipses, one under the other. Avoid 8 or 8 .

Avoid 9 .

Draw zero in two strokes. It is an ellipse, not a circle.

Letters

We shall note the features of each of the letters as we did the numerals. Again, complete each line with about ten copies of the letter. Note the individual steps in forming each letter.

Exercise 9

Base is as wide as height. Avoid

Avoid

The two strokes in opposite directions avoid a tilted letter.

Avoid

Avoid

Avoid

Avoid
. There are NO serifs on drafting letters.

The letter i and numeral one are the same. Serifs:

Avoid

C O

F P

Avoid P

C O Q

I P R

Avoid R R

S S

T

U U

V V

V V W W

X

Avoid X

V V Y

Z

Avoid Z

Exercise 10: Making Letters

1. (Fill in the blank.) Some letters are made wider at the bottom to give an appearance of _____.
2. The letter which is similar to E is _____. To X _____.
To V _____. To C _____. To U _____.
3. What letters are similar to Q? _____.
To R? _____.

Spacing Letters and Words

It is a contradictory fact that if the letters in a word are each spaced an equal distance apart, they will NOT appear that way to the eye. For example observe:

DISTANCE, GO, IN, LAY,

The distance from the extreme right end of each letter to the extreme left end of the next letter is equal in each case but the I and A in "distance" appear too far from the letters beside them; the spacing in "go" seems wider than in "in"; and the Y in "lay" seems to be away off by itself. The fact is that for letters to appear evenly spaced it is the areas of the spaces between the letters that should appear equal, not the end-to-end distances. Thus letters with curved sides are placed closer to one another than the average spacing, as are letters with slanting sides. Compare the two lines below:

DISTANCE, GO, IN, LAY,
DISTANCE, GO, IN, LAY,

Rather than worry with hard and fast rules for spacing every pair of letters that may come together, you can use your own judgment in spacing to try to get the letters in each word so that they look uniformly spaced.

Spacing between words should be at least as wide as a standard letter such as H or N.

All lettering on drawings should be done between ruled guide lines even if only one short word is involved. Dimension numerals should all be the same height. You may be able to accomplish this without guide lines but if not, don't be reluctant to rule guide lines even though only one numeral may be required. See that all guide lines are very light and made with a very sharp pencil. Do not attempt to erase them from the finished drawing in pencil drawings.

To get a feel for good spacing copy the following example.

Exercise 11: Spacing Between Letters and Words

Do all work on the nine pairs of 3 mm guide lines drawn below
Fig. 1-19.

FINE FILE METAL FILAMENT WAX FILLET MANY A KINK
KEYWAY LIMIT LOCATION OF OIL HOLE CONNECTING LINK
CHUCK MOUNTING HIGH QUALITY ALUMINUM JOURNAL BOX
MOTOR GENERATOR DADO JOINT DOUBLE-HUNG WINDOW
POPPET VALVES PISTON RINGS 120 INCH WHEEL BASE
BRONZE BEARINGS AIRPLANES ZOOM IN THE SKY
FULL VACUUM SYSTEM EQUIPPED WITH AMPLIFIERS
PUBLIC SCHOOLS INDUSTRIAL ARTS DEPARTMENT
SCALE: FULL SIZE DRAWING A-425 9-10-1938

Fig. 1-19 Practice in spacing words and letters

The image shows nine sets of horizontal guide lines, each consisting of two parallel lines. These lines are intended for practicing the spacing of words and letters in handwriting.

LESSON RECORD FORM

Introductory Drafting SI

FOR STUDENT USE ONLY

Date Lesson Submitted

Time Spent on Lesson

(If label is missing
or incorrect)

File Number

Lesson Number _____

Student's Questions and Comments

Apply Lesson Label Here

Name _____

Address _____

Postal Code _____

*Please verify that preprinted label is for
correct course and lesson.*

FOR SCHOOL USE ONLY

Assigned
Teacher: _____

Lesson Grading: _____

Additional Grading
E/R/P Code: _____

Mark: _____

Graded by: _____

Assignment Code: _____

Date Lesson Received:

Lesson Recorded _____

Teacher's Comments:

ALBERTA DISTANCE LEARNING CENTRE

MAILING INSTRUCTIONS FOR CORRESPONDENCE LESSONS

1. BEFORE MAILING YOUR LESSONS, PLEASE SEE THAT:

- (1) All pages are numbered and in order, and no paper clips or staples are used.
- (2) All exercises are completed. If not, explain why.
- (3) Your work has been re-read to ensure accuracy in spelling and lesson details.
- (4) The Lesson Record Form is filled out and the correct lesson label is attached.
- (5) This mailing sheet is placed on the lesson.

2. POSTAGE REGULATIONS

Do not enclose letters with lessons.

Send all letters in a separate envelope.

3. POSTAGE RATES

First Class

Take your lesson to the Post Office and have it weighed. Attach sufficient postage and a green first-class sticker to the front of the envelope, and seal the envelope. Correspondence lessons will travel faster if first-class postage is used.

Try to mail each lesson as soon as it has been completed.

When you register for correspondence courses, you are expected to send lessons for correction regularly. Avoid sending more than two or three lessons in one subject at the same time.

Using the Drawing Instruments, DimensioningUse of the Drawing Board and T-Square

Instead of free-hand sketching, you are now going to use the drafting instruments. All drawing, except sketching, should if possible be done on the drawing board. The T-square and drawing board together provide the means by which all horizontal and vertical lines are kept parallel with one another and with the edges of the paper. Your T-square is a precision instrument whose head is exactly at right angles to the blade, and whose blade is as nearly straight as quality will permit. On the other hand the sides of the drawing board may not be so precisely square, so if the head of the T-square is switched over from one side of the board to the other, the lines drawn may not be truly parallel. So make a habit of placing the head of the T-square always against one side of the drawing board only. This may be the left side, but if you are left handed you may use the right side. In either case always stay with the same side. Every time you use your instruments first wipe the board and T-square free of dust.

Fastening Drawing Paper on the Drawing Board

Use the drawing paper supplied with the lessons. If your board has a surface which is at all rough it is a good idea to line the surface with a layer or two of smooth paper covering the surface of the board. Attach the lining paper with masking tape at the top.

We now want to place the drawing paper on the board so that

- (1) it is perfectly flat when attached in place
- (2) it is lined up so that the drawing will appear straight on the page.

This is another of those operations which may seem to be so simple that no explanation is required. But unless the correct method is followed the paper will not lie flat and square on the board and trouble will result when using the T-square.

The edges of the paper may not be cut exactly square so we shall line up the top edge and disregard any discrepancies in the others. Proceed as follows, after wiping board and T-square free of dust. (Wipe the top edge of the T-square to remove lead particles.)

1. Place the sheet in the upper left portion of the drawing board about 150 mm from the left edge and 100 or 125 mm below the top. With the paper in this region you will have arm freedom, and the head of the T-square, being close at hand, can be readily kept firmly against the edge of the board.

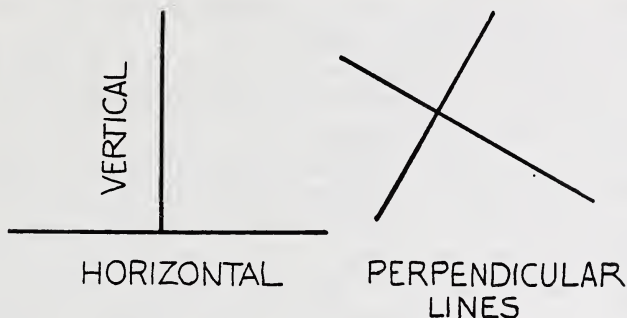
2. Fasten the upper-left corner of the paper only. The best way to do this is to use a small piece of masking tape about 12×20 mm. Do not use cellophane tape as it can not be removed from the paper again cleanly.
3. With the head of the T-square held firmly against the edge of the board, line the top edge of the paper up with the upper edge of the T-square.
4. With one hand, hold the paper firmly in position; with the other hand, slide the T-square down toward the center of the sheet. Hold it firmly while changing hands to make one hand free.
5. With the palm of the hand, stroke the paper snugly to the board working from the upper-left corner to the lower-right corner. Fasten the lower-right corner.
6. Smooth the paper firmly toward the upper-right corner and fasten.
7. Check to see that the upper edge of the paper still lines up with the T-square.
8. Stroke the paper from the center toward the lower-left corner and fasten.

Exercise 1: Fastening Paper on the Drawing Board

1. Why should you wipe the instruments each time you prepare to work?

2. Why must you carefully smooth the paper before fastening it?

3. Why use masking tape in fastening rather than cellophane tape?

Drawing Horizontal and Vertical Lines

Horizontal lines are lines that run from side to side across the paper.

Vertical lines lie up and down on the paper.

Vertical and horizontal lines meet each other at right angles. Lines which meet at right angles are said to be perpendicular to each other.

Horizontal lines are drawn using the UPPER edge of the T-square. The head of the T-square is always held firmly against the same edge of the drawing board. The place where the line is to be drawn having been marked with a light horizontal dash, proceed as follows:

1. Place the pencil point on this dash.
2. Slide the T-square up to the pencil point.
3. Draw the line from left to right, sliding the fingers along the blade of the T-square as you draw.

NOTE: The pencil is placed in position on the dash first and then the T-square is brought up to the pencil. Otherwise, if the reverse procedure were used, the exact allowance for the pencil width would not be made.

4. Hold the pencil so it is tipped in the direction that the hand moves and slightly outward as shown in Fig. 2-2. The point of the pencil must be against the blade as it touches the paper. Keep the pencil in the same position throughout to make sure that the line will be perfectly straight.
5. Apply uniform pressure and roll the pencil slightly between the thumb and fingers as the line is drawn.
6. Do NOT track the pencil back and forth.

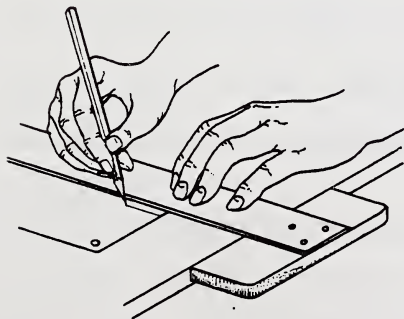


Fig. 2-2. Drawing a Horizontal Line

To draw vertical lines, proceed as follows:

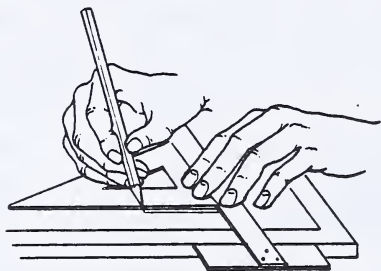


Fig. 2-3. Drawing a Vertical line

1. Use a triangle along with the T-square.
2. Place the T-square so that the blade is below the line to be drawn.
3. Hold the pencil point on the vertical dash which marks the position of the vertical line.
4. Keep one of the perpendicular sides of the triangle flush with the top of the T-square blade and slide the triangle along until it touches the pencil point.
5. Draw the line from a point near the T-square up toward the top

of the triangle letting the fingers slide along the triangle. Use the other hand to keep the triangle snug against the T-square, and the T-square head snug against the side of the drawing board.

Exercise 2: Drawing Horizontal and Vertical Lines

1. Why should you roll the pencil when drawing a straight line?

2. In making a straight line, the straight edge should be brought up to the desired point and then the pencil placed against it. _____

3. The pencil may be tracked back and forth when ruling lines. _____
(In 2 and 3 answer "True" or "False".)

4. When drawing, is the head of the T-square always held against one edge of the board, or may it be changed from side to side?

5. Horizontal lines are drawn with the _____ edge of the T-square only. (Fill in the blank.)

Locating Lines with a Pencil

The location of any particular line will usually have to be found by measuring. Suppose we want to draw a horizontal line 25 mm down from the top of the drawing paper. Place T-square and triangle on the paper as previously instructed. Now lay your scale measure along the vertical edge of the triangle. Draw a short, light, HORIZONTAL dash after placing the point of the pencil at the mark on the scale which is 25 mm from the paper's edge. The dash should be horizontal so that it will become part of the horizontal line when it is drawn. Do not make a heavy dot or an X or your measuring marks will stick out from the finished drawing. Measurement marks for vertical lines should be short vertical strokes.

The type of measuring scale used should be one which is bevelled so that the scale marks meet the surface of the paper. Any thickness of material between the scale indications and the paper will result in inaccurate measurements. An architect's scale or engineer's scale is best for the purpose.

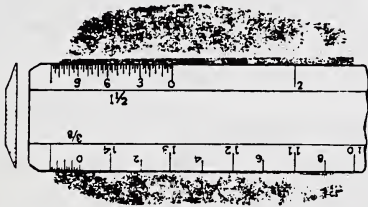


Fig. 2-4. Bevelled scale

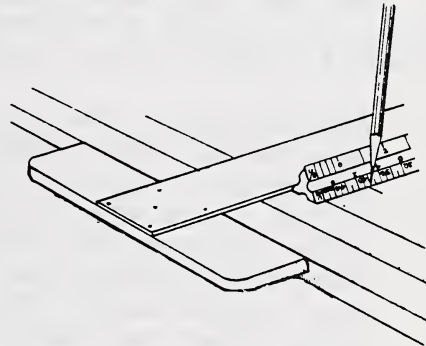


Fig. 2-5. Triangular scale being used to make a short, light dash to indicate position of a vertical line.

Exercise 3: Locating Lines with a Pencil

1. The pencil is pointed with a (chisel, conical) point. (Cross out the wrong word.)
2. In drawing a line through a point, the pencil is placed on the mark first and the T-square or triangle is then brought to it. _____
3. A large dot is the best way to mark the location of a line. _____
(In 2 and 3, answer "True" or "False".)

Steps in Making a Working Drawing

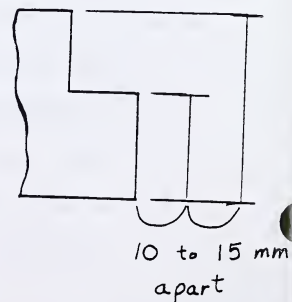
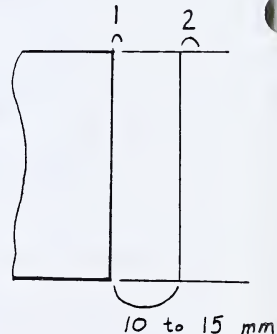
1. The paper is fastened to the drawing board with the long side horizontal. The method used to ensure that the paper lies flat was stated at the beginning of this lesson.
2. The necessary measurements are made to locate the lines which will be drawn.
3. The outlines of the object in each view are drawn using the measurements and construction lines explained in Lesson 1.
4. Space is provided between the views to allow for the insertion of all necessary dimensions.
5. The dimensions are inserted. All the drawing has so far been done with a 4H pencil.
6. The object lines (only) are heavied up with an H pencil.

When you come to making up finished plates of working drawings, the paper will be first ruled with proper border and title strips, but this step is omitted in the present lesson.

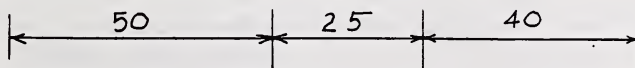
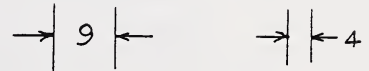
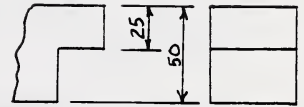
Dimensioning a Working Drawing

We shall now discuss dimensioning so that you will know how to space out the lines of working drawings so that the dimensions can be inserted in their correct places.

1. After blocking in the views, make the extension lines distinct with the 4H pencil. Many of them will lie on top of construction or projection lines so they can be shown by heavying up a portion of the projection line slightly with the 4H pencil. Start each extension line 1 mm from the object edge line and make it long enough to extend 2 mm beyond the dimension lines when drawn.
2. Place dimension 10 mm or more from the object. (Never crowd the dimensions against the side of the object.) If there is more than one dimension place them evenly apart as in Figs. 2-6 and 2-7. Uniform placing of dimension lines not only makes the drawing look better, but it makes it more convenient to read.
3. With 4H pencil draw each dimension line so it starts and stops EXACTLY at the extension line. Leave no opening since the dimension figure is now placed above the line.
4. Make neat arrowheads at each end of a dimension line, placing them so the points are exactly at the extension lines. In the next section we shall give you instructions on how to draw arrowheads.

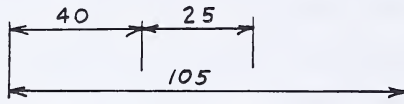


5. Make the figures for the whole numbers 3 mm high. Fractions are not used with SI.
6. The dimension figures refer to the size of the finished object, NOT to the drawing lengths. If all dimensions are in the same units do not include the unit with the dimension figure. In this course all dimensions are for the most part in millimetres so just use the numbers and OMIT the "mm."
7. The figures for horizontal dimensions should read from the bottom of the drawing: E.g. 50 The figures for vertical dimensions should read from the right side: E.g. 25
8. Keep dimensions OUTSIDE the object whenever possible. Sometimes this cannot be done without long extension lines, in which case they must go within the object as in Fig. 2-7.
9. Place dimensions BETWEEN views whenever two views can be dimensioned with one line, but apply each dimension to one view.
10. Give a dimension of a single part ONLY ONCE even though that part appears in several views.
11. When there are several short and long dimensions together place the short ones next to the view and the longer ones farther out so that extension lines do not cross dimension lines.
12. When a space is too small to place dimension lines between the extension lines, place short dimension lines outside of the extension lines. The figure can be placed inside the extension lines if there is enough space or it can be outside of the extension lines if the space between is too small for a figure.
13. When there are several dimensions in a row, the dimension lines should form a single line.

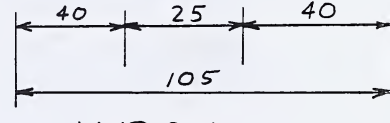


NOTE: There will often be several object and extension lines in line with one another. Try to anticipate this and draw all of them with a single setting of the T-square, or triangle and T-square in the case of vertical lines. There is no harm in drawing a single long construction line very lightly and then going over the portions of this which are required for object edge lines and extension lines.

14. When a length is broken down into parts do not duplicate a dimension by dimensioning all the parts AND the total length.



RIGHT



WRONG

NOTE: Always give the total length instead of one of the smaller dimensions.

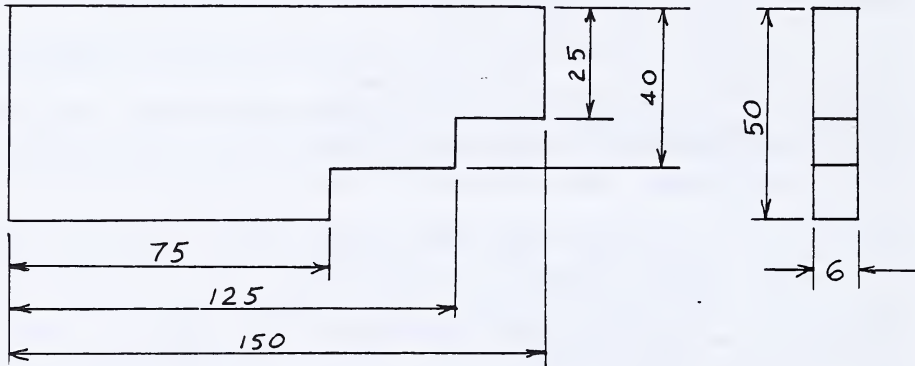


Fig. 2-6. Dimensioned drawing of window stick

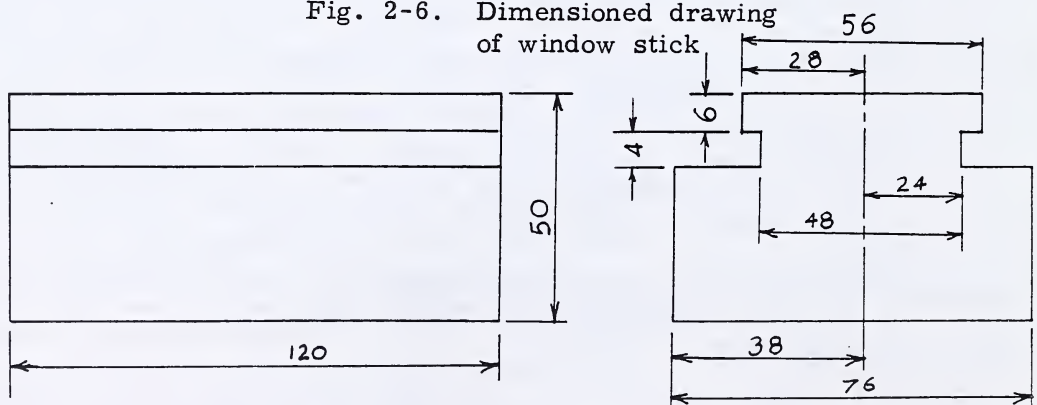


Fig. 2-7. Grooved block. Note dimensioning from center line in side view.

Exercise 4: Dimensioning a Working Drawing

1. A working drawing must include dimensions. _____
(Answer "True" or "False".)
2. In making dimension lines and extension lines, I would use a _____ H pencil. (Fill in the blank.)
3. Whole numbers are _____ mm high.
4. Extension lines should continue
 - (a) 12 mm
 - (b) 18 mm
 - (c) 9 mm
 - (d) 2 mm beyond the arrowheads.(Underline the correct length.)
5. Place dimensions (beside, under, between) views whenever possible.
(Underline the correct word.)
6. Every working drawing must show all dimensions on all the views even though the edges are repeated. (Answer "True" or "False".)

Arrowheads

1. Make arrowheads with a 4H pencil.
2. The arrowhead should be very slender and the sides should be graceful curves. The approximate sizes are shown in the drawing but these may vary to suit the space and in accordance with your own individual styling. But do not shade in the space between their sides. Any solid pencil shading tends to smudge.
3. The two curves are made with a single stroke: from outer end to point and back to the other outer end.

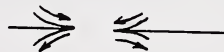
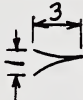


Fig. 2-8. Enlarged arrowhead

Fig. 2-9. Direction of pencil strokes

Exercise 5: Drawing Arrowheads

Attach a sheet of drawing paper to your drawing board as instructed in this lesson. Then draw six 50 mm horizontal and six 50 mm vertical lines with T-square and triangle and put an arrowhead on each end of every line. Make your arrowheads like those in Fig. 2-9.

Laying Out a Drawing Sheet

The drawing sheets you use in this course are behind the last lesson. Enough sheets are supplied to enable you to complete the course. The sheets measure 216 X 280 mm. We shall make our drawings within a 204 X 254 mm border. Please make the borders you require for this lesson. Starting with the next lesson, you may use the plates with the borders already drawn on them.

To prepare a sheet ready for setting a drawing on requires the following steps.

1. Fasten the paper on the drawing board as described earlier in this lesson. Keep it toward the upper left of the board well away from the ledge at the bottom of the board.
2. Find the center of the sheet.
3. Rule the 204 X 254 mm border.
4. Rule a record strip at the bottom of the sheet 11 mm wide above the border. (The sheet is to be placed lengthwise on the drawing board.)

Do all ruling very lightly with a 4H pencil.

Finding the Center

Place the blade of your T-square across the sheet with the upper edge from the top left corner of the paper to the bottom right corner. Rule a line near the middle of this distance. Then move the blade and place it from bottom left to top right corner of the paper. Rule a short line which crosses the first line. Where the lines cross is the center of your drawing paper.

Ruling the Border

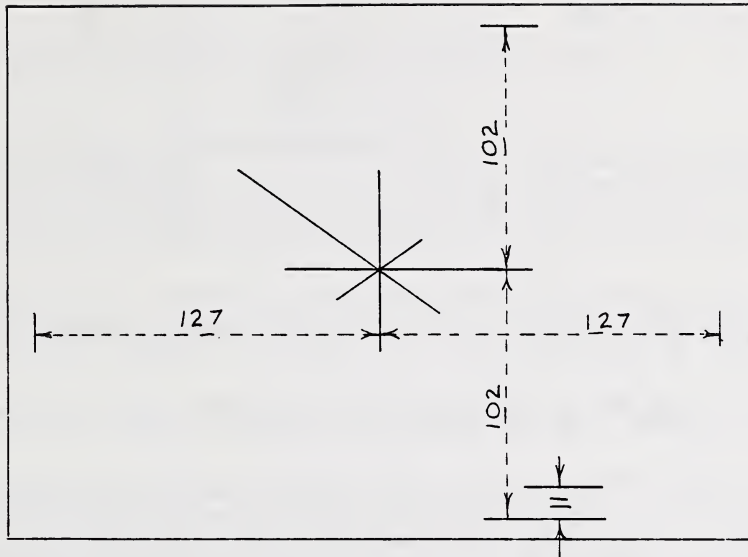
With T-square draw a horizontal line about 30 mm long through the center. Place a triangle on the T-square and draw a short vertical line through the center.

Measure 102 mm up from, and 102 mm down from the horizontal line to locate your horizontal borders.

Measure 11 mm up from the bottom border to give you the top line of the record strip.

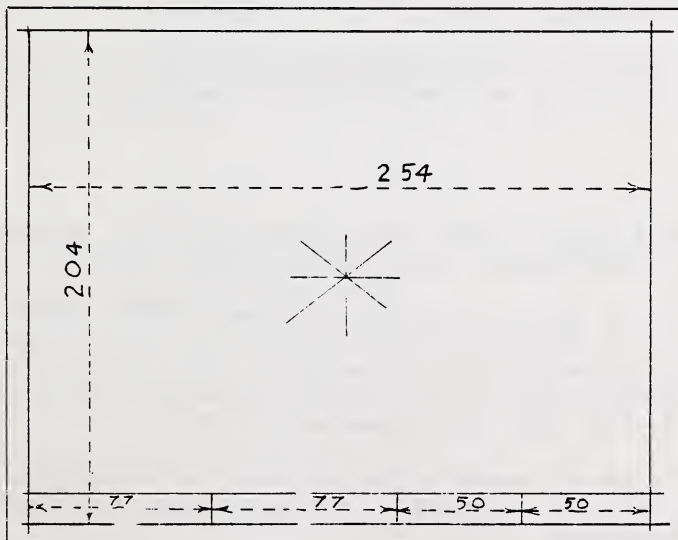
Measure 127 mm to left and right of the vertical line to locate your vertical borders.

Your sheet will now show the construction lines and measurement strokes illustrated. Of course the dimensions on our illustration will not appear on your sheet.



Partitioning the Record Strip and Ruling the Borders

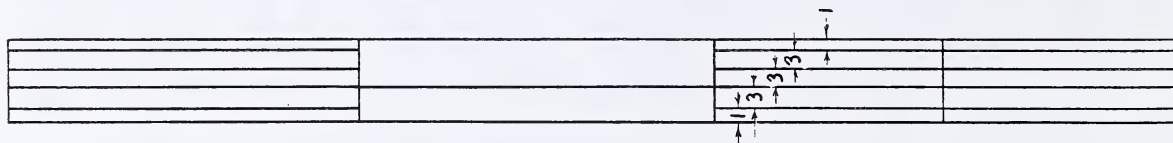
Measure distances 77 mm, 77 mm, 50 mm apart starting from the left border, within your record strip. Now use the T-square to draw all the horizontal lines required and use T-square and triangle to draw all the vertical lines required. You should end up with the lines lightly drawn in this way:



The light lines should overlap slightly at the corners. Leave things that way until the drawing is entirely completed. Then the required border lines will be heavyed up. The heavy lines must MEET EXACTLY at the corners. No overlaps or gaps are then acceptable.

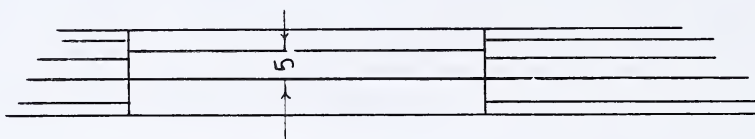
Ruling the Record Strip

Now rule the guide lines for lettering in the record strip as shown below.



Rule the horizontal guide lines in section 1, and in sections 3 and 4 with a single setting of the T-square.

Finally, draw a second guide line in section 2, 5 mm above the first.



The drawing sheet has now been provided with the light outlines of a 204 X 254 mm border with an 11 mm record strip at the bottom divided into 77, 77, 50, 50 mm sections ruled with guide lines for lettering. Such a sheet is called a plate.

Exercise 6: Preparing Plates

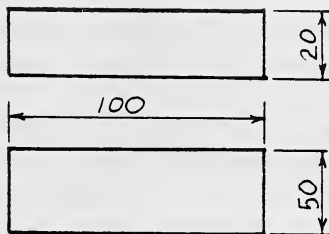
Prepare 2 plates as instructed above. We shall use each of them to make a finished drawing on. Use the blank sheets provided after the last lesson.

Blocking In

Whatever drawing is to be made, it will be first necessary to center it on the plate before any of the details can be drawn in.

Nothing can be done on the drawing board until a sketch has first been made freehand on a separate piece of paper. This will show you all the items which must appear on the drawing in their proper relative positions. With this information you will be able to see where the center of the drawing is, and then lay out your measurements accordingly.

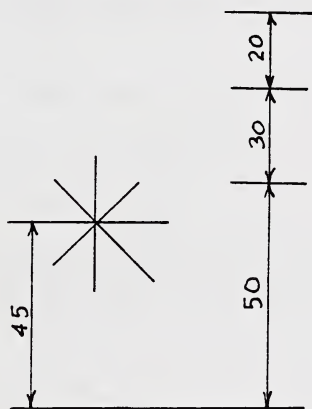
Take the following example. The drawing is for a rectangular block so two views are adequate. Suppose we decide to draw the front and top views. Our sketch is like this:



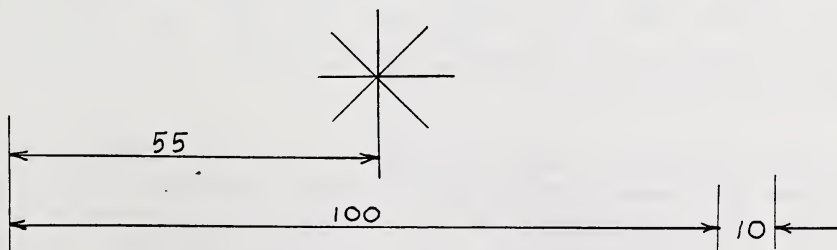
We will leave 30 mm between views for dimensioning and so the over-all height of the drawing is 100 mm. The dimensions on the right project about 10 mm so the over-all length is 110 mm.

Now you have as your starting point the center of the plate which was what you found as the first procedure in laying out your plate.

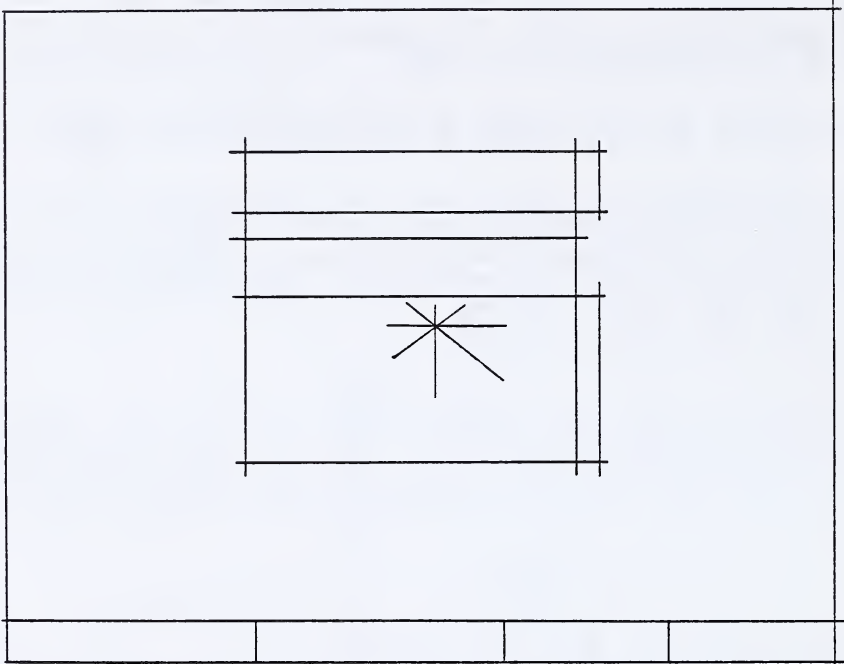
Since our drawing is to be 100 mm high, measure down half this distance from the center, namely 50 mm. However the center of the plate is not the center of the drawing because 11 mm was taken up by the record strip. So to center the drawing deduct 5 mm. The bottom of the drawing will be 45 mm below the center. Starting then, 45 mm down from the center, mark the horizontal lines you will require:



The over-all length of the drawing is 110 mm (allowing 10 mm for dimensioning), so the left edge of the drawing will be 55 mm from the center. Note the line locations shown below.



You now have the positions of your 5 horizontal lines and 3 vertical lines marked. With T-square rule all the horizontal lines from the top one down. Then place a triangle on the T-square and draw all the vertical lines, in order, starting at the left side. When the blocking in has been done you will have these lines, all very lightly drawn with your 4H pencil:



Your drawing has now been blocked in so that it is centered on the plate and fills the space available adequately.

The extension lines, dimension lines, and arrowheads can now be outlined on top of these guide lines. When the dimension numerals have been inserted, the object edge lines, borders, and record strip partitions heavied up with H pencil, and the record strip lettered, the drawing will be complete.

It is not necessary to draw continuous lines when blocking in. You can see from your sketch where gaps should occur and you can make the extension lines the correct length to begin with, instead of drawing them on top of a continuous line. But the important thing is to line up all segments which are in line and draw them with a single setting of the T-square, or triangle.

FRONT and SIDE VIEWS:

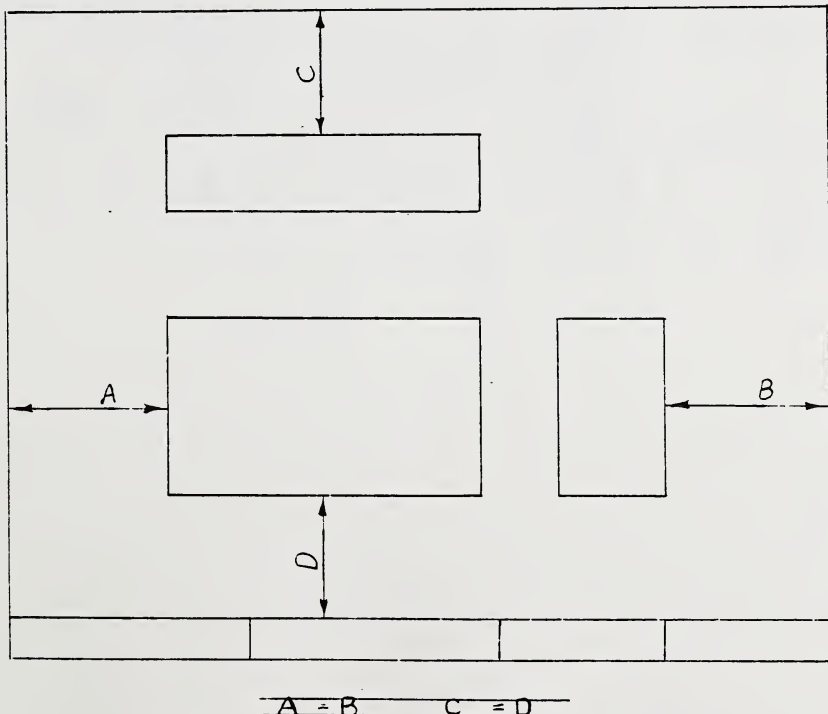
If your drawing consists of front and side views, add together all the lengths you will require including enough space for dimensions, as determined from your sketch, divide by two, and then measure off this distance to the left of your center line, to find the left end of the drawing.

Similarly, find the total height you will require and measure down half of this distance from the center, but subtract 5 mm to allow for the off-centering effect of the record strip.

THREE VIEWS:

The same system is used for a 3-view drawing. The left end of the front view will be as far from the left border as the right end of the right-side view (including dimension lines) is from the right border.

Similarly for top and bottom of drawing, as illustrated.



Using the Drawing Instruments to Make a Working Drawing

You are now going to use your drawing board, T-square, triangles, and scale to make the drawing shown in Figs. 2-6 and 2-7, on page 8. Use the proper methods we have discussed in Lesson 1 and in this lesson.

Exercise 7: Using the Drawing Instruments to Make a Working Drawing

Copy the two drawings, Fig. 2-6 and Fig. 2-7, full-size, each on the sheets of drawing paper, prepared with borders in Exercise 6 and give all dimensions. Use your hard or 4H pencil for laying out the drawing. Afterwards, go over the object outlines with the soft, or H pencil. Remember to carry out all the instructions you have learned:

1. Fasten the paper to the board with the long side horizontal, carrying out each step as instructed in this lesson. Remember that there is a best way to do things. Resolve to use that way at the outset so as to make your work easier and your success greater.
2. Before you can locate any of the lines you are to draw, you will have to center the drawings on the pages. Follow the methods outlined on pages 12 to 15.
3. Now draw the lines as instructed under "Drawing Horizontal and Vertical Lines". Object edges are to be gone over with a soft H pencil after the drawing is laid out.
4. The record strip is to be lettered as follows.

ACS	OBJECT	DR. BY	DATE
		CH. AP.	SCALE

After DR. BY (drawn by), sign your name. After CH. (checked) write your initials after you have checked to see that all details of your drawing are correct. AP. stands for "approved". If your drawing is found to be correct your correspondence teacher may initial it.

LESSON RECORD FORM
Introductory Drafting SI

FOR STUDENT USE ONLY		FOR SCHOOL USE ONLY
<div style="text-align: center; padding-bottom: 10px;">Date Lesson Submitted</div> <div style="border-bottom: 1px solid black; height: 20px; margin-bottom: 10px;"></div> <div style="text-align: center; padding-bottom: 10px;">Time Spent on Lesson</div> <div style="border-bottom: 1px solid black; height: 20px;"></div>	<div style="padding-bottom: 10px;">(If label is missing or incorrect)</div> <div style="padding-bottom: 10px;">File Number</div> <div style="border-bottom: 1px solid black; height: 20px; margin-bottom: 10px;"></div> <div>Lesson Number</div> <div style="border-bottom: 1px solid black; height: 20px;"></div>	<div style="padding-bottom: 10px;">Assigned Teacher: <div style="border-bottom: 1px solid black; width: 100px;"></div></div> <div style="padding-bottom: 10px;">Lesson Grading: <div style="border-bottom: 1px solid black; width: 100px;"></div></div> <div style="padding-bottom: 10px;">Additional Grading E/R/P Code: <div style="border-bottom: 1px solid black; width: 100px;"></div></div> <div style="padding-bottom: 10px;">Mark: <div style="border-bottom: 1px solid black; width: 100px;"></div></div> <div style="padding-bottom: 10px;">Graded by: <div style="border-bottom: 1px solid black; width: 100px;"></div></div> <div style="padding-bottom: 10px;">Assignment Code: <div style="border-bottom: 1px solid black; width: 100px;"></div></div> <div style="padding-bottom: 10px;">Date Lesson Received:</div> <div style="border-bottom: 1px solid black; height: 20px; margin-bottom: 10px;"></div> <div>Lesson Recorded <div style="border-bottom: 1px solid black; width: 50px;"></div></div>
<div style="display: flex; align-items: center;"><div style="width: 30%; border: 1px solid black; padding: 5px;"><div style="text-align: center; padding: 5px;">Student's Questions and Comments</div><div style="height: 250px; border: 1px solid black;"></div></div><div style="width: 40%; text-align: center; padding: 5px;"><div style="writing-mode: vertical-rl; transform: rotate(180deg);">Apply Lesson Label Here</div><div style="border: 1px solid black; border-radius: 15px; padding: 10px; margin: 10px auto; width: 80%;"><div style="display: flex; justify-content: space-between; align-items: flex-end;"><div style="width: 20%; text-align: center;">Name <div style="border-bottom: 1px solid black; height: 40px;"></div></div><div style="width: 20%; text-align: center;">Address <div style="border-bottom: 1px solid black; height: 40px;"></div></div><div style="width: 20%; text-align: center;">Postal Code <div style="border-bottom: 1px solid black; height: 40px;"></div></div></div></div><div style="writing-mode: vertical-rl; transform: rotate(180deg);"><i>Please verify that preprinted label is for correct course and lesson.</i></div></div></div> <div style="width: 30%; padding: 5px; vertical-align: top;"><div style="padding-bottom: 10px;">Teacher's Comments:</div><div style="height: 150px; border: 1px solid black;"></div></div>		

ALBERTA DISTANCE LEARNING CENTRE

MAILING INSTRUCTIONS FOR CORRESPONDENCE LESSONS

1. BEFORE MAILING YOUR LESSONS, PLEASE SEE THAT:

- (1) All pages are numbered and in order, and no paper clips or staples are used.
- (2) All exercises are completed. If not, explain why.
- (3) Your work has been re-read to ensure accuracy in spelling and lesson details.
- (4) The Lesson Record Form is filled out and the correct lesson label is attached.
- (5) This mailing sheet is placed on the lesson.

2. POSTAGE REGULATIONS

Do not enclose letters with lessons.

Send all letters in a separate envelope.

3. POSTAGE RATES

First Class

Take your lesson to the Post Office and have it weighed. Attach sufficient postage and a green first-class sticker to the front of the envelope, and seal the envelope. Correspondence lessons will travel faster if first-class postage is used.

Try to mail each lesson as soon as it has been completed.

When you register for correspondence courses, you are expected to send lessons for correction regularly. Avoid sending more than two or three lessons in one subject at the same time.

Drafting Lines and Working DrawingsLines Used in Drafting - See Lesson 1, pages 8 and 9.

In Lesson 1 we described in detail the types of lines and what they are used for. You have also drawn object lines, border lines, dimension and extension lines, and guide lines with your instruments, and you have used hidden edge lines in your sketches.

We now want you to draw a display plate of all the types of lines with your T-square and drawing board, paying attention to the details of their lengths and weights as set out in the Check List on pages 8 and 9 of Lesson 1. Estimate the lengths of dashes, gaps, etc. after measuring the first ones you draw.

Exercise 1 Lines of a Working Drawing

Copy the lines in Fig. 1-7 to Fig. 1-13, inclusive, page 8, Lesson 1, on a prepared plate. Arrange the lines in two columns, four lines to a column, each line 75 mm long. Center the drawing on your plate. Be sure to make each line the right weight — heavy or light. Letter the proper title under each line, using 5 mm guide lines. (Omit "Fig. 1-7", etc.) Title the finished plate, CONVENTIONAL DRAWING LINES.

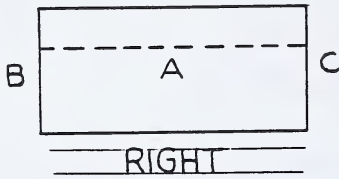
Hidden Edge Lines

From the exercise you have just done you should know how to space out the dashes in hidden edge lines.

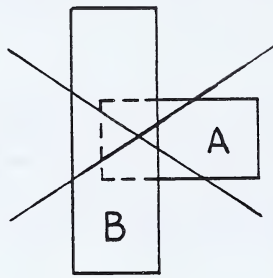
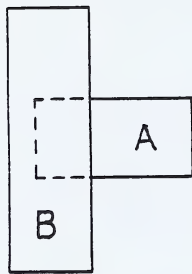
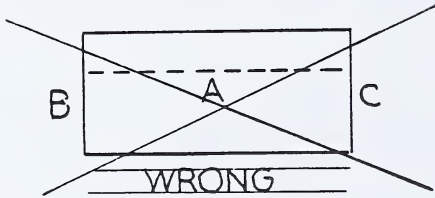
There are two problems which arise when using these lines on drawings.

1. What do we do when hidden edges and visible edges meet?
2. What do we do when hidden edges meet each other?

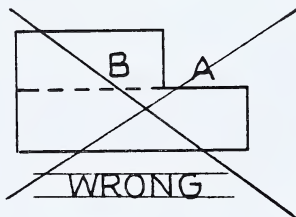
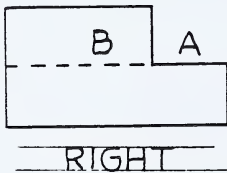
We can best answer these questions by illustrating the situations with drawings.



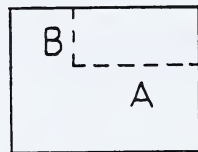
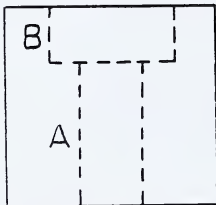
Hidden edge A meets surfaces B and C. Note that the dashes MEET the visible edge lines.



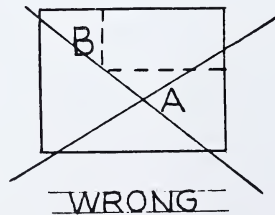
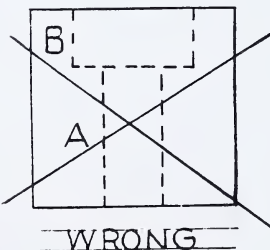
Peg A fits into socket B. The hidden edge lines are a continuation of peg A. Where A becomes invisible, a SPACE is left.



Visible edge A does not extend beyond the vertical edge. A SPACE is left between A and B.



Hidden edges A and B meet. The dashes must also meet.

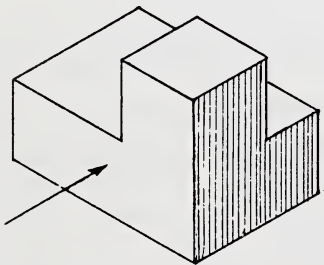


Exercise 2 Hidden Edge Lines

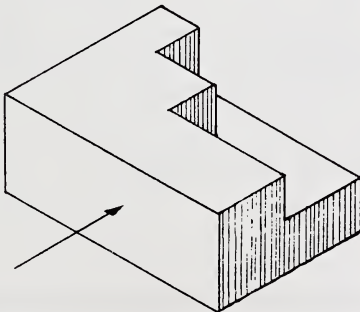
(Cross out the incorrect words in the following pairs:)

1. A hidden outline is made up of (short, long) dashes (evenly, unevenly) spaced. For the line to be (light, heavy), it (is, is not) heavied up with the H pencil.
2. Where a hidden line meets a visible object line, the dash (should, should not) meet the solid line.
3. Where two hidden surfaces meet, the two sets of dashes (should, should not) meet.
4. When a visible outline is a continuation of a hidden outline, the dash (should, should not) meet the solid line.
5. In the space to the right of each object sketch the face indicated by the arrow, as a front view, showing all hidden lines required correctly drawn.

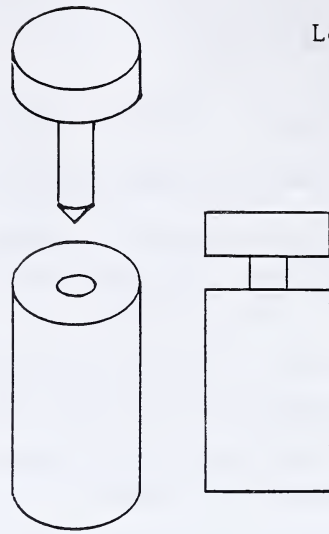
(a)



(b)



- (c) Complete the hidden edge lines required in the socket if the plug is to fit snug all around and at its bottom.



Oblique or Inclined Lines

An oblique or inclined line is one which is neither horizontal nor vertical. Such a line lies at an angle with the horizontal. Your triangles and T-square enable you to draw lines at angles of 30° , 45° , 60° , or 90° with the horizontal. When drawing lines at these angles always place one edge of the triangle along the blade of the T-square, not along a previously drawn horizontal line alone.

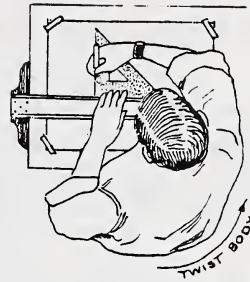
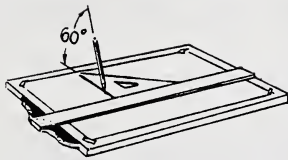
The triangles can also be used to draw angles of 15° and 75° , as we shall see.

Drawing oblique or inclined lines

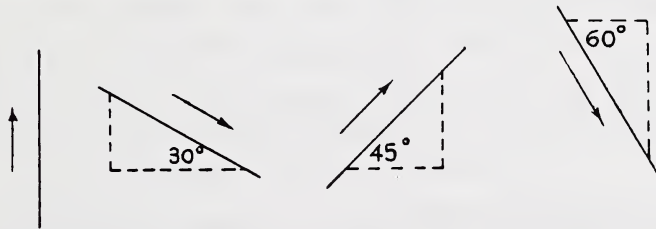
("Oblique" and "inclined" mean the same thing.)

When you are drawing horizontal lines, you draw them from left to right, provided you are right handed. (If you are left handed, then all lines we shall mention should probably be drawn in the reverse direction to that mentioned.) It seems the natural thing to do, to draw from left to right. But there is a reason why this seems so natural. As you place the pencil point against the T-square blade, your hand and your pencil slope naturally toward the right. (Your pencil makes an angle of 60° with the paper, in the vertical plane.) Thus as you move so you PULL your hand and pencil along the blade. You pull the pencil: you DO NOT push it.

We want to draw all inclined lines so that the pencil will be pulled, not pushed, along the edge of the triangle. So we draw vertical lines UPWARD with the wrist curved as shown in the illustration.

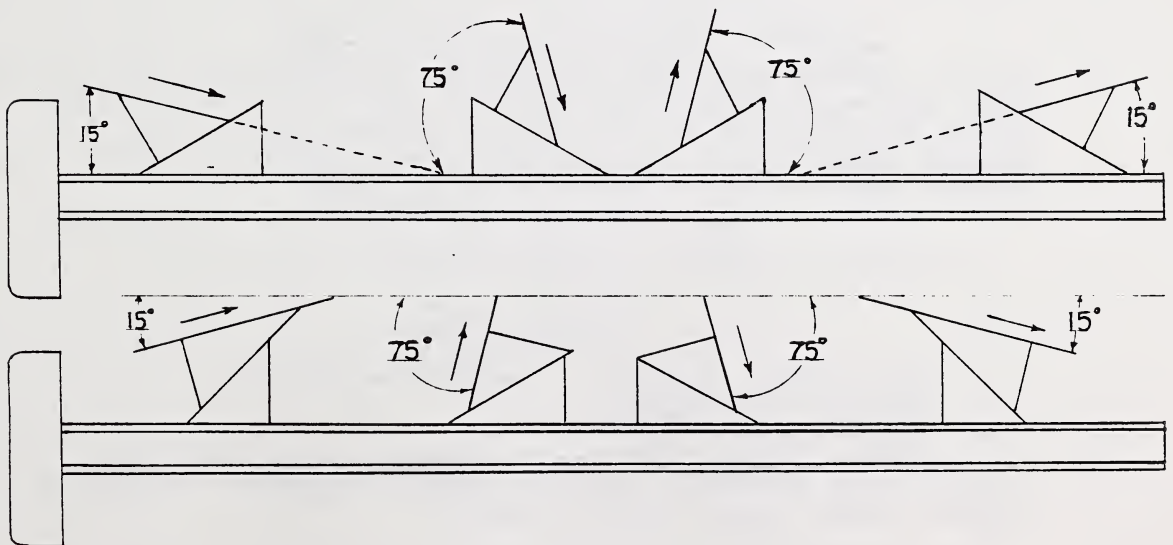


Again, so that we are pulling the pencil we draw inclined lines so that we start at the left and finish at the right end of the line, thus:



Using the two triangles to draw angles of 15° , and 75°

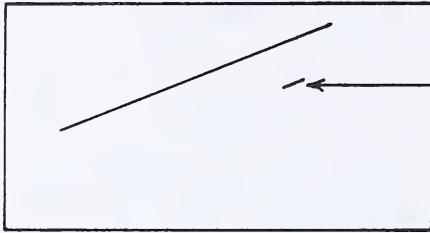
Place the triangles longest sides together, as shown in the drawing below, to get angles of 15° or 75° with the horizontal or vertical.



Parallel Lines

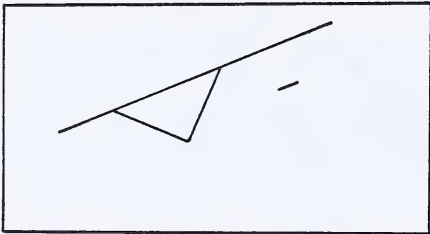
Use the following steps to draw any number of lines parallel to a given inclined line.

1. Suppose the given line is slanted like this.

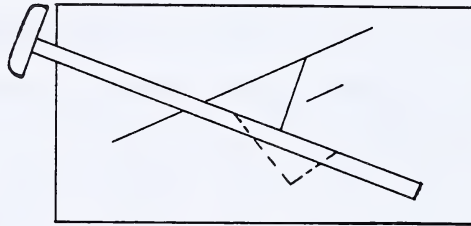


We want to draw a parallel line through this point.

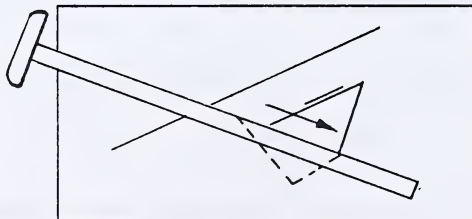
2. Set the long edge of either triangle along the line.



3. Set EITHER the T-square blade or the long edge of the other triangle along one of the other edges of the first triangle.



4. Slide the first triangle along to where the desired parallel line is to go, place your pencil point on the mark and secure this triangle's edge against it. Then draw the line along the triangle edge. It will be parallel to the original line. Make sure your T-square or second triangle remains firmly in place during the sliding.

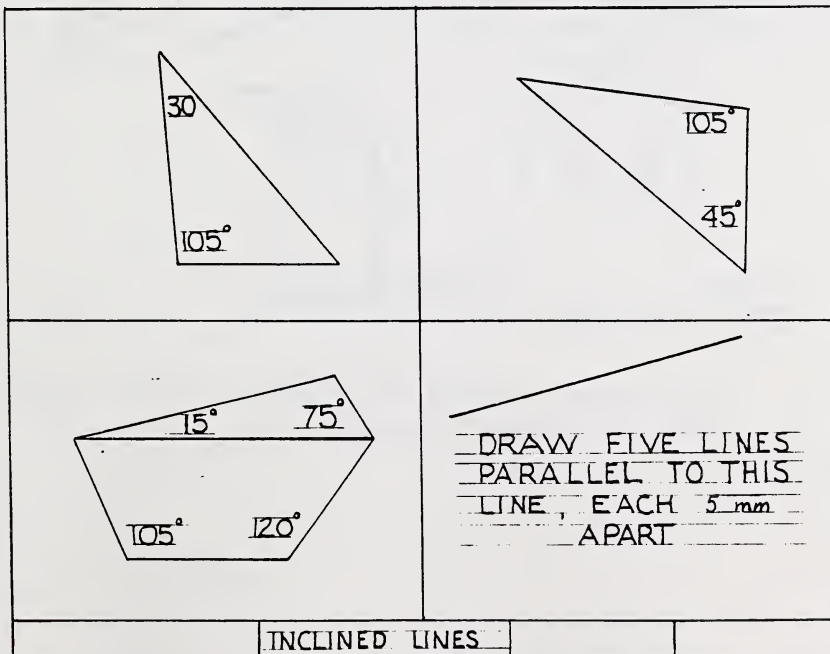


5. Any number of parallel lines can be drawn by sliding the first triangle along to different positions, always keeping the T-square or second triangle securely fixed in position.

Exercise 3 Drawing Inclined Lines and Parallel Lines

1. The triangle can be used without the aid of the T-square for drawing vertical lines. _____ (Answer "True" or "False".)
2. To draw a line 75° with the horizontal, place the $30^\circ - 60^\circ - 90^\circ$ triangle against the T-square and place the $45^\circ - 45^\circ - 90^\circ$ triangle against the first triangle. (Circle the angle that you use in each triangle.)
3. Why are inclined lines drawn in the direction shown in the figures on page 5?

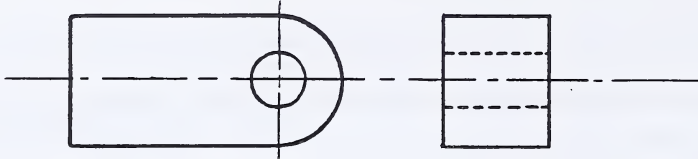
4. Lines can be drawn parallel to a line that has already been drawn by using a triangle and T-square. _____ (Answer "True" or "False".)
5. If you have only three or four closely spaced parallel lines to draw, it would be easier to use another triangle for a guide instead of the T-square. _____ (Answer "True" or "False".)
6. Attach a sheet of drawing paper on your drawing board (a prepared plate). Use T-square and triangles to draw the following figures. Use your own judgement as to the sizes of the figures but try to make them large enough that no line is less than 50 mm long. The angles illustrated are not drawn the correct sizes.



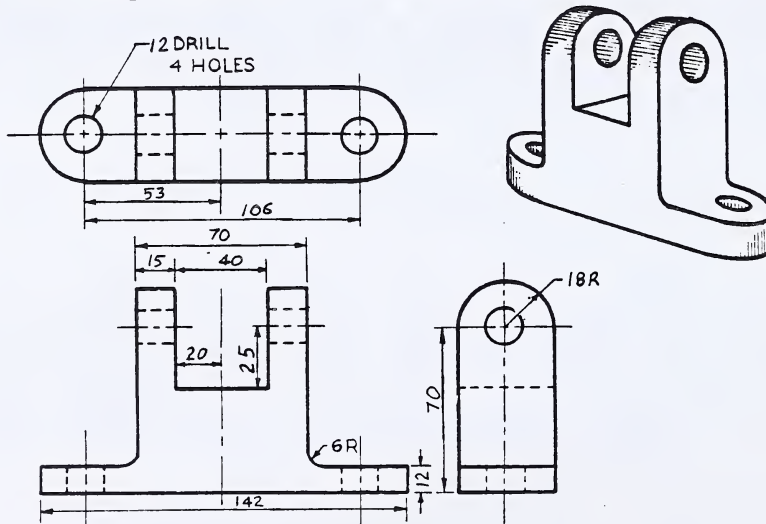
Number of Views in a Working Drawing

Whatever object a draftsman is required to draw, he must decide what views are necessary in order to show clearly the exact construction of the object. A flat, wafer-like object like a gasket, would require only one view. A uniform rectangular block can be completely represented by two views.

When holes are bored in a surface, they will show as circles in the view facing the hole. In the view at right angles they will appear as hidden edges. See the drawing below. (Note the center lines.)



If the object has holes at right angles to each other, it is well to draw three views so that all holes will be represented both as circles and as hidden edges. Center lines are drawn at right angles for each hole so that the location of the hole centers can be indicated by dimension lines. (Holes are located by their centers, not by their edges.) Study the following example.

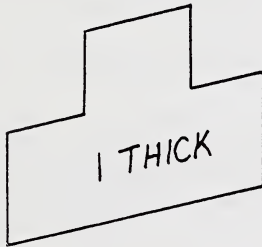


The working drawing above requires three views to show all necessary details.

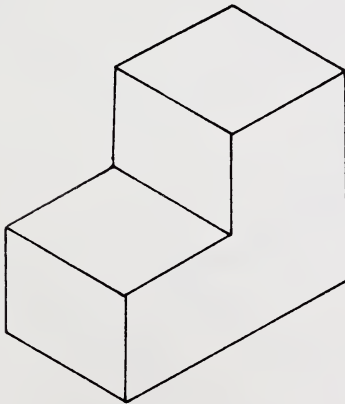
Exercise 4: Number of Views

Decide how many views would be needed to show each of the following objects on a working drawing. Then sketch the views properly lined up in relation to each other. Do not draw more views than would be necessary. Position the objects to show edges as visible rather than hidden, but show all hidden edges where necessary. Neglect dimensions. Draw your sketches with a hard pencil in the space below.

1. The object shown is a template. It is used for reproducing multiple outlines of its shape by tracing around the edges. The edges of the template are all at right angles though the pictorial view does not show them that way. Sketch the working drawing with all angles true size.

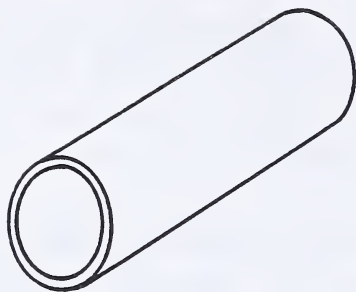


2.



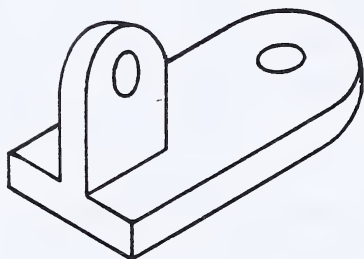
Seat

3.



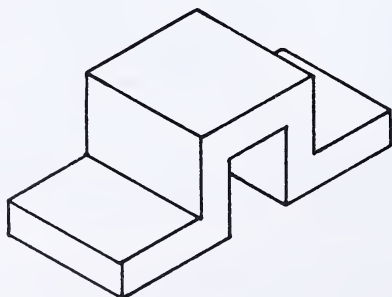
Pipe

4.



Mounting Bracket

5.



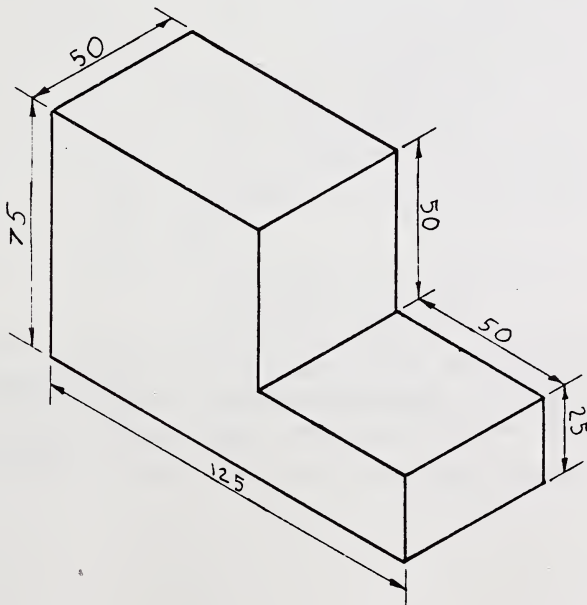
Yoke

Check List for Drawings

1. Is the drawing centered on the plate?
2. Is it neat and free from smudges?
3. Are the views in proper relation to each other?
4. Have the views been correctly projected?
5. Are there center lines for all circles and symmetrical objects?
6. Are all dimensions provided?
7. Are the dimensions found easily with related dimensions together so the workman will not have to hunt for them?
8. Have you repeated any dimensions? If so erase the one which is more remote.
9. Do all dimension figures and notes read from the lower right corners of the drawing?
10. Is your lettering style the correct standard set out in Lesson 1?
11. Are all words spelled correctly?
12. Are all arrowheads drawn in?
13. Are all object lines, hidden edges, border lines and record partitions heavied up with H pencil?
14. Do all lines meet exactly at corners when heavied up?
15. Have all erasing particles been brushed off?

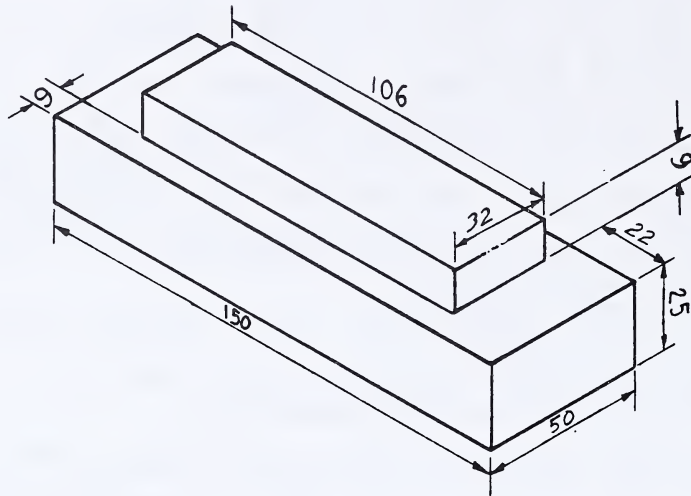
Exercise 5: Working Drawings in Orthographic Projection

1. First sketch a 2-view working drawing of the Seat on a separate piece of paper, then lay out the views on a prepared plate and make a finished working drawing complete with dimensions and correct weights of lines properly centered. Letter the record strip. Attach sketch to finished plate.

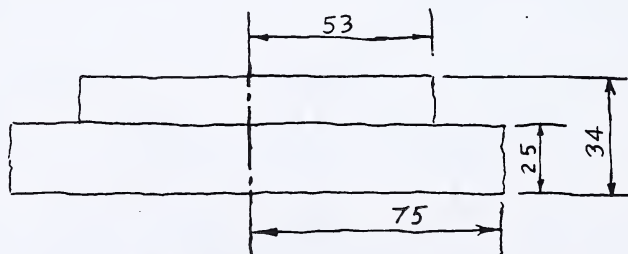


NOTE: Sketches may be done on looseleaf or other paper, and they do not have to be full size.

2. Sketch front and top views of the Weight. Then make a complete working drawing on a prepared plate. (Attach your sketch to your plate.)



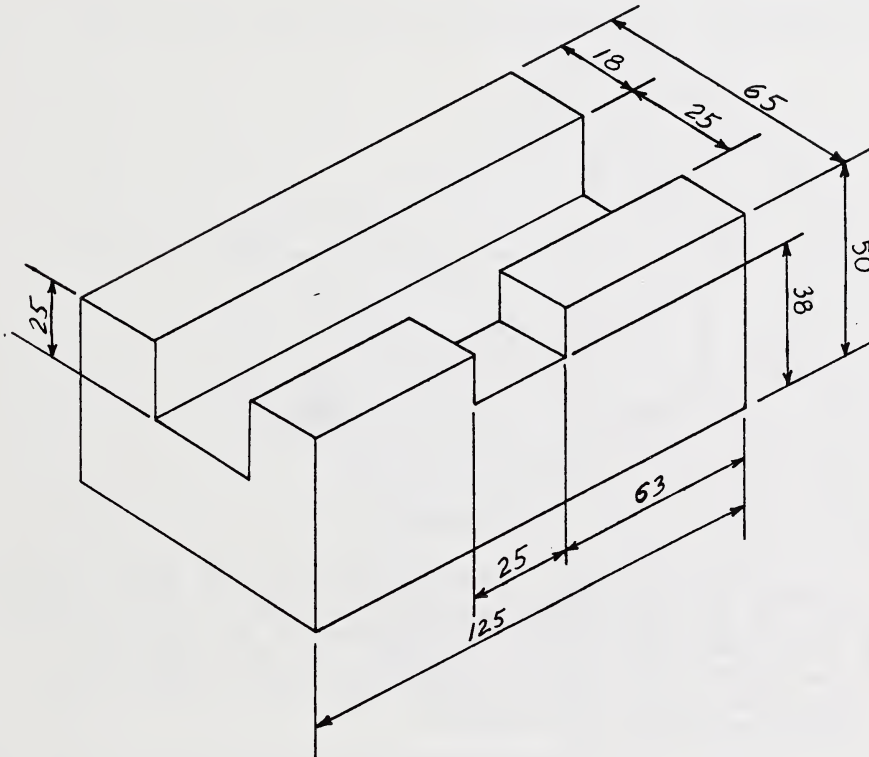
When object is symmetrical
dimensioning is simplified
if you dimension from a
center line.



(Partial sketch. Add top view.)

Before sending in your lesson check each drawing with the check list we provided.

3. Sketch a front, top, and left side view of the following object. Then make a good plate of these three views. Be sure all views and edges are properly aligned.



GROOVED BLOCK

Note: In this course, the old $8\frac{1}{2}$ by 11 inch paper has been used for convenience. This turns out to be 216 by 280 mm. The corresponding SI (metric) paper would be 210 mm \times 297 mm. The metric paper would therefore have slight variations in the dimensions of the record strip and border.

Problem 4 Draw the top and front views of the U-Block.

Outside dimensions, 50 X 75 X 125 mm

Groove in center of the upper

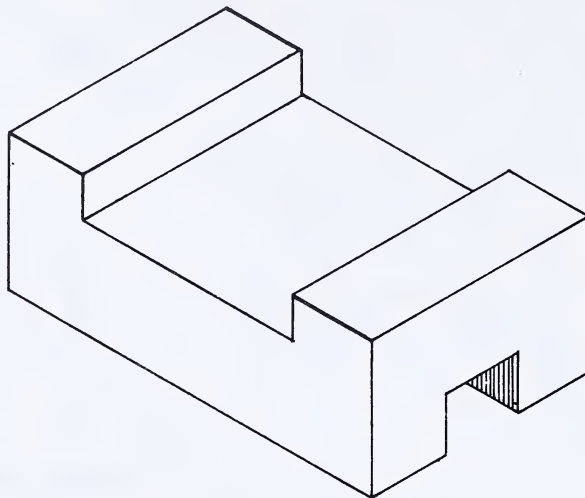
face, 15 X 75 mm

Groove in center of the bottom,

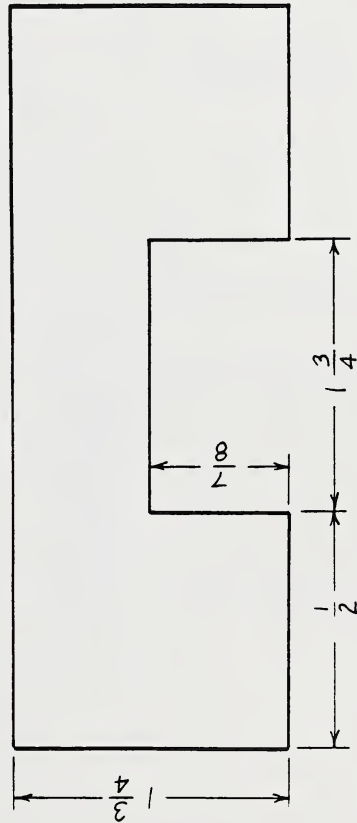
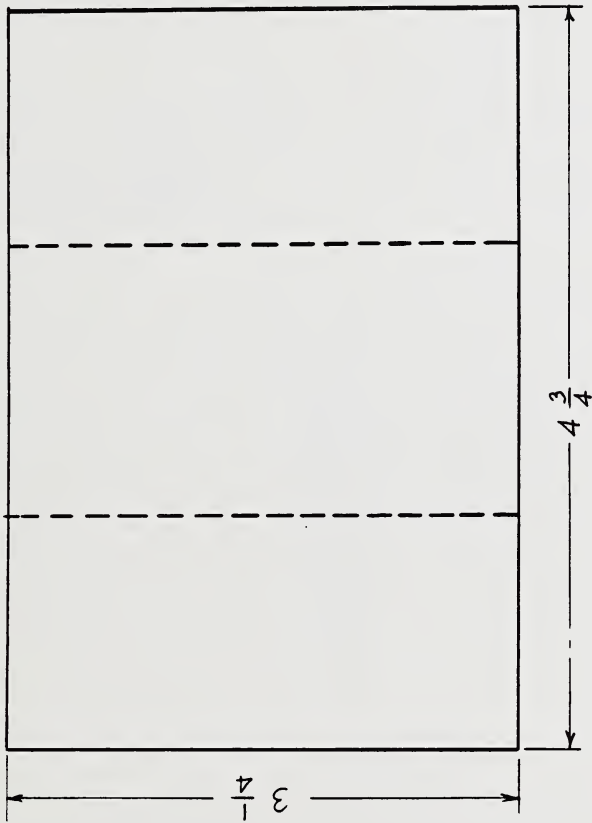
15 X 25 X 125 mm

(Top view and one other. Be sure that the second view which you draw is in the correct position relative to the top view. Make a freehand sketch of the views first.)

All necessary dimensions must be correctly shown in each problem.



Note: In SI, fractions are not used, however, you may come across an old plate with fractions on it. The enclosed plate of the Channel Block indicates the conventions to be used when inches and fractions of an inch are to be used. Note how the bar of the fraction is aligned, and how high the fraction is in comparison to the whole number. Also note the gap in the dimension line where the numbers are placed.



AC.S.	CHANNEL BLOCK	DR. BY <i>Wm. Boyd</i>	DATE: 1978-11-10
		CH. <i>W.B. AP</i>	SCALE: 1:1

LESSON RECORD FORM
Introductory Drafting SI

FOR STUDENT USE ONLY

Date Lesson Submitted

Time Spent on Lesson

(If label is missing
or incorrect)

File Number

Lesson Number _____

**Student's Questions
and Comments**

Apply Lesson Label Here

Name _____

Address _____

Postal Code _____

*Please verify that preprinted label is for
correct course and lesson.*

FOR SCHOOL USE ONLY

Assigned
Teacher: _____

Lesson Grading: _____

Additional Grading
E/R/P Code: _____

Mark: _____

Graded by: _____

Assignment Code: _____

Date Lesson Received:

Lesson Recorded _____

Teacher's Comments:

ALBERTA DISTANCE LEARNING CENTRE

MAILING INSTRUCTIONS FOR CORRESPONDENCE LESSONS

1. BEFORE MAILING YOUR LESSONS, PLEASE SEE THAT:

- (1) All pages are numbered and in order, and no paper clips or staples are used.
- (2) All exercises are completed. If not, explain why.
- (3) Your work has been re-read to ensure accuracy in spelling and lesson details.
- (4) The Lesson Record Form is filled out and the correct lesson label is attached.
- (5) This mailing sheet is placed on the lesson.

2. POSTAGE REGULATIONS

Do not enclose letters with lessons.

Send all letters in a separate envelope.

3. POSTAGE RATES

First Class

Take your lesson to the Post Office and have it weighed. Attach sufficient postage and a green first-class sticker to the front of the envelope, and seal the envelope. Correspondence lessons will travel faster if first-class postage is used.

Try to mail each lesson as soon as it has been completed.

When you register for correspondence courses, you are expected to send lessons for correction regularly. Avoid sending more than two or three lessons in one subject at the same time.

Pictorial Drawings

Pictorial Drawing

So far in this course we have considered working drawings in Orthographic Projection. When an object is represented in this way we always have two or more views which are detached from each other. The advantage of drawing these views is that they show clearly the true sizes and shapes of edges so that measurements can be made and dimensioning done relatively easily. However, they have one obvious disadvantage: the drawings do not give a very clear idea of what the finished article looks like.

The difficulty in drawing objects on paper is that objects in space have three dimensions whereas the paper has only two. We are all used to photographs and have come to accept photographs and what we see on the television screen as true representations of the original views. So realistic are they that we forget they are flat whereas the real people, houses, rooms, etc. they portray are solid objects in space.

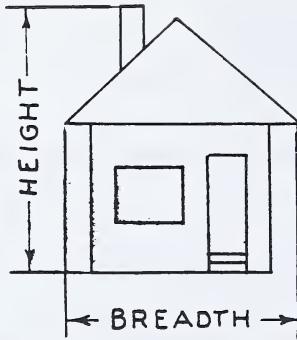
How does a photograph give the impression of three-dimensional space even though it is flat? It does it by means of perspective, and by highlights and shaded regions.

A drawing which, like a photograph, gives an impression of three-dimensional space, is called a pictorial drawing. The most realistic type of pictorial drawing is perspective drawing.

Perspective Drawing

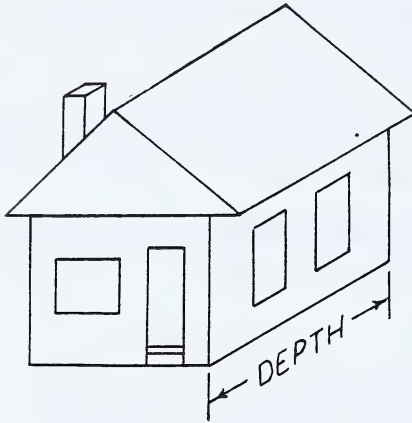
For purposes of drafting, perspective drawing has some disadvantages, but we shall consider it briefly to show how it gives the impression of space. Then we shall see how the device used to give this impression is retained in the pictorial drawings used in drafting while the disadvantages of perspective drawing are dispensed with.

If you look at the sheet of paper on which these words are printed you may consider the up-and-down (vertical) dimension as indicating height while the side-to-side (horizontal) dimension indicates breadth. Thus the front view of a house appears thus:

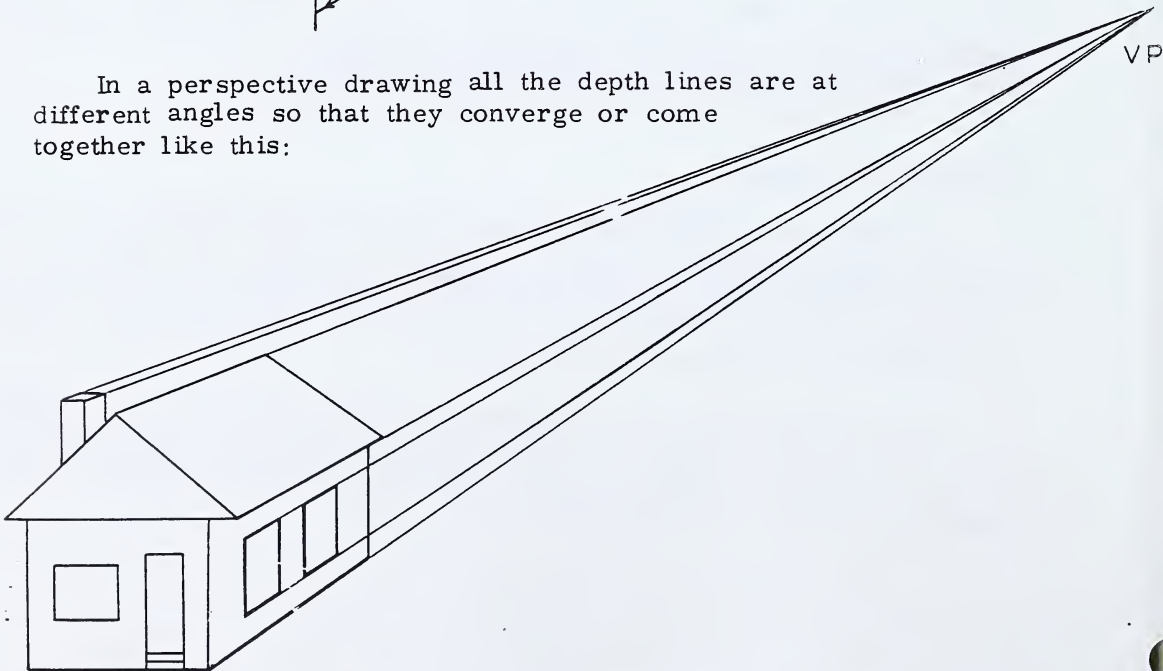


The portion of the house behind the front view must be shown by somehow indicating another dimension which is really perpendicular to the plane of the paper.

So we draw this dimension on the paper by drawing lines at an angle with the horizontal. All lines at this angle represent lines in the "depth" dimension.

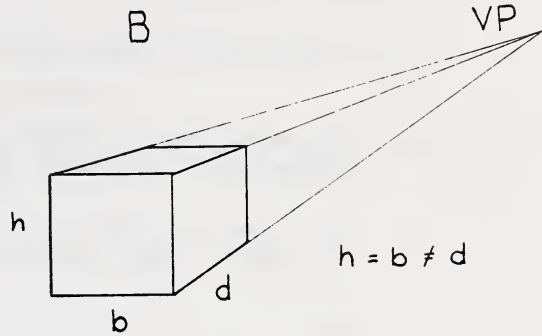
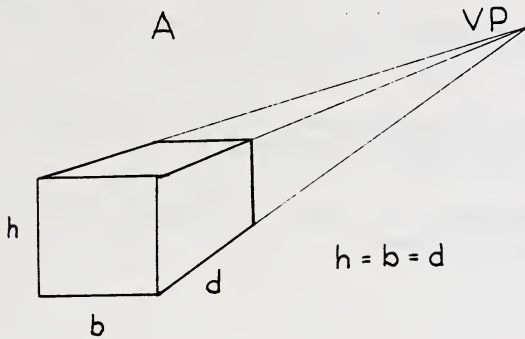


In a perspective drawing all the depth lines are at different angles so that they converge or come together like this:



The point at which all the lines in the depth dimension converge is called the vanishing point.

Now consider a cube (all edges of equal length) drawn in this way, as shown at A.



The cube at A looks, does it not, as if the edges along the depth were longer than either those of the height or breadth? To overcome this appearance, in a perspective drawing lengths along the depth dimension are foreshortened, that is, they are made less than the true length. The amount of this foreshortening may vary, according to the judgement of the maker of the drawing. The cube, drawn in perspective, looks as in B.

In a perspective drawing, then:

1. The third, or depth, dimension is shown at an angle with the horizontal.
2. The lines along the depth dimension converge to a vanishing point.
3. The true lengths along the depth dimension are foreshortened, gradually shrinking more and more for distances farther and farther from the observer.

The cube above was drawn in one-point perspective. One face of the cube was perpendicular to the line of sight of the observer but the cube was to his left and below eye level.

Corresponding to one-point perspective in drafting is oblique projection. Just as with one-point perspective, the object is drawn so that one face is perpendicular to the line of sight of the observer and the object is to his left and below eye level. Now for drafting purposes items 2 and 3 above are disadvantages since they prevent us from measuring true depth or true height in the plane which includes the third dimension. These disadvantages are overcome in oblique projection. There are two types of oblique projection called Cavalier Projection and Cabinet Projection. We shall now see how each of these overcomes the disadvantages of one-point perspective.

OBLIQUE PROJECTIONS

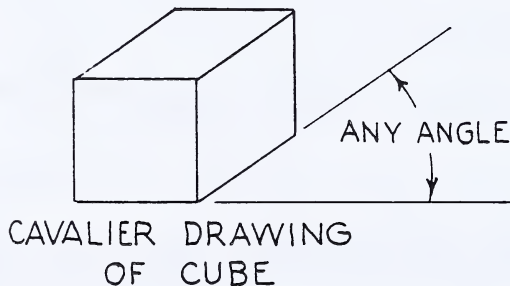
Cavalier Drawing

In cavalier drawing the two conditions for oblique projection are met:

1. The front face is drawn facing the observer just as it appears in orthographic projection and one-point perspective.
2. The depth dimension is represented by lines at an angle with the horizontal. (Any angle may be chosen.)

But:

1. All lines in the depth direction are parallel (so there is no vanishing point).
2. All lengths are retained as true lengths along the depth dimension. The cube appears like this:



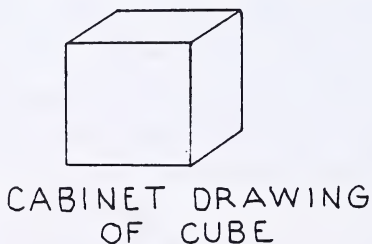
It is interesting to note that cavalier projections originated in the drawing of medieval fortifications, hence the name "cavalier" which can mean either a medieval soldier, or a raised fortified structure.

Pictures on old tapestries and pictures of the early forts in North America were drawn using this projection.

The obvious disadvantage of this projection is that objects appear to be deeper than they really are.

Cabinet Drawing

In this type of oblique projection exactly the same procedure is used as in cavalier drawing except that all lengths in the depth dimension are reduced to HALF SIZE.



This style of drawing originated in the furniture industry. It is a satisfactory method of depicting objects in which the front view is more important than the sides or top.

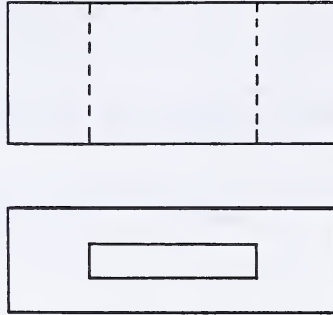
Exercise 1: Oblique Projection

In the spaces provided draw the sketches called for. They need not be to scale but keep the sizes in proportion.

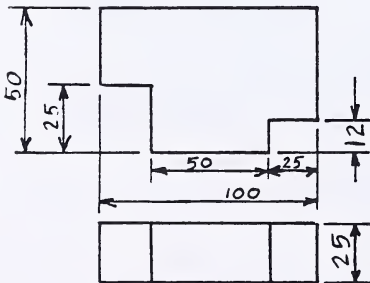
1. (a) Make a cavalier drawing of a rectangular block 40 mm \times 50 mm \times 80 mm.

-
- (b) Make a cabinet drawing of the same block.

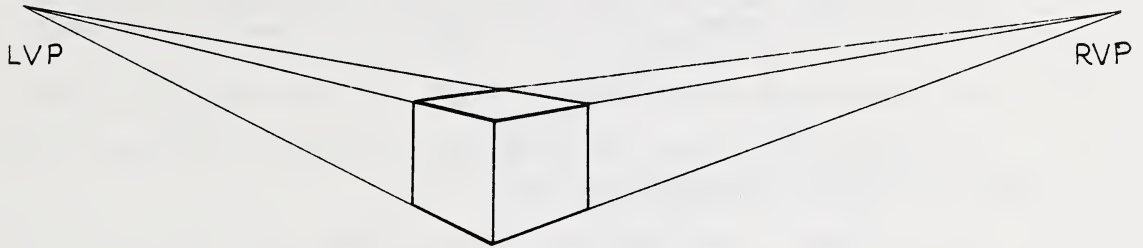
2. Make a cabinet drawing of the Mortised Piece using the same Front View as is given in the Orthographic Projection shown below.



3. Make a ONE-POINT perspective drawing of the following block. Clearly show the vanishing point.



We have discussed one-point perspective drawing. If no face of a cube is perpendicular to the line of sight of the observer then the cube must be represented by two-point perspective. Suppose a corner of the cube is directly in front of the observer but below eye level. Then the perspective drawing would be like this:



There are two vanishing points. Horizontal lines to the left of the front corner converge to the left vanishing point and horizontal lines to the right of the observer converge to the right vanishing point. Again we have two disadvantages from the standpoint of the practical workman:

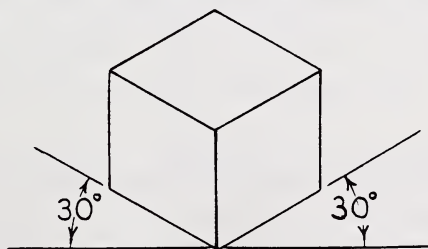
1. Horizontal distances are not shown true length.
2. Vertical distances are not shown true length except for those at the front corner.

However the two-point perspective drawing gives a clear idea of the features of two sides and the top of the object. In isometric drawing we retain these advantages and eliminate the above two disadvantages.

Isometric Drawing

In isometric drawing:

1. One corner of the object is immediately in front of the observer.
2. Horizontal lines of the object on both Left Side and Right Side of this corner are all drawn at 30° to the horizontal on the paper.
3. All horizontal and vertical lengths on the object are shown true length on the drawing.



Isometric drawing of cube

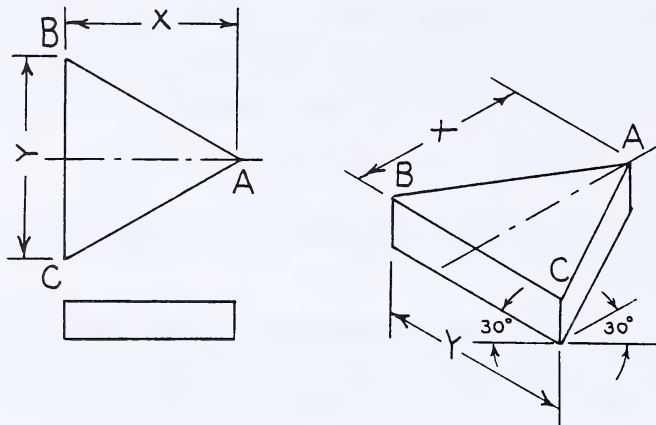
"Isometric" means "of equal length". The advantage of this type of drawing is that all lengths which are vertical or horizontal in the original object appear as true lengths on the drawing. (Horizontal lines on the object are all tilted 30° to the horizontal on the drawing.)

On the other hand, any line which is NOT horizontal or vertical on the object does NOT appear true length on the isometric drawing.

All lines which are drawn true length are called isometric lines.


All oblique lines (lines which are not horizontal or vertical) on the object are called non-isometric lines.

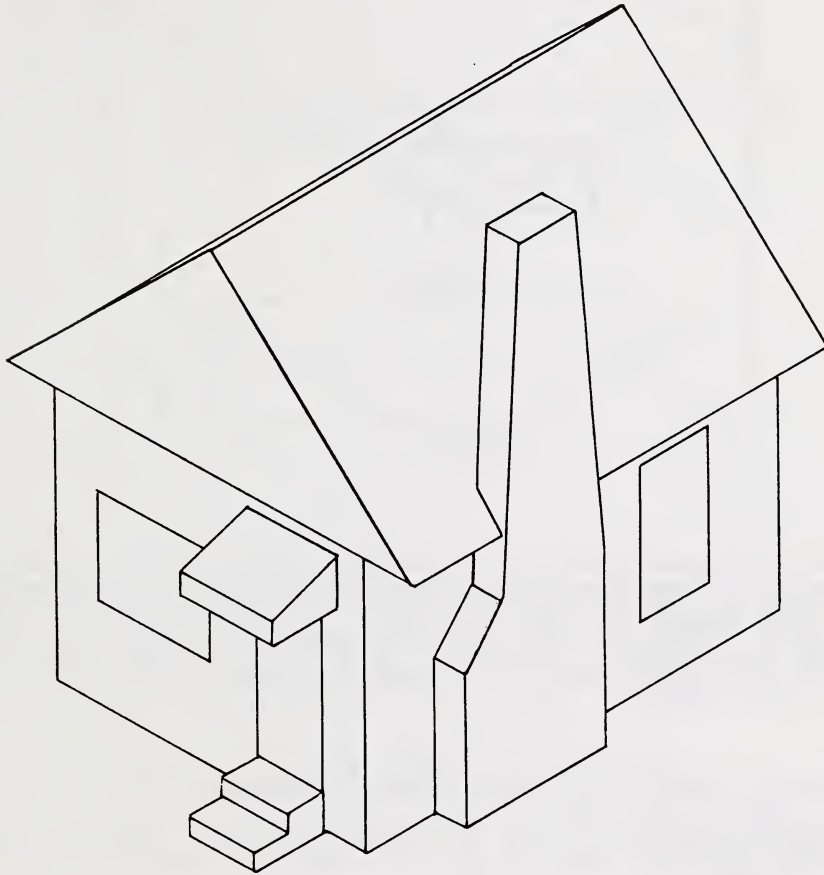
For example, in the isometric drawing shown here the top face is



an equilateral triangle. BC is drawn true length. AC and AB represent the other two equal sides of the triangle. However AC is plainly shorter than BC while AB is longer than BC on the drawing. AC and AB are non-isometric lines.

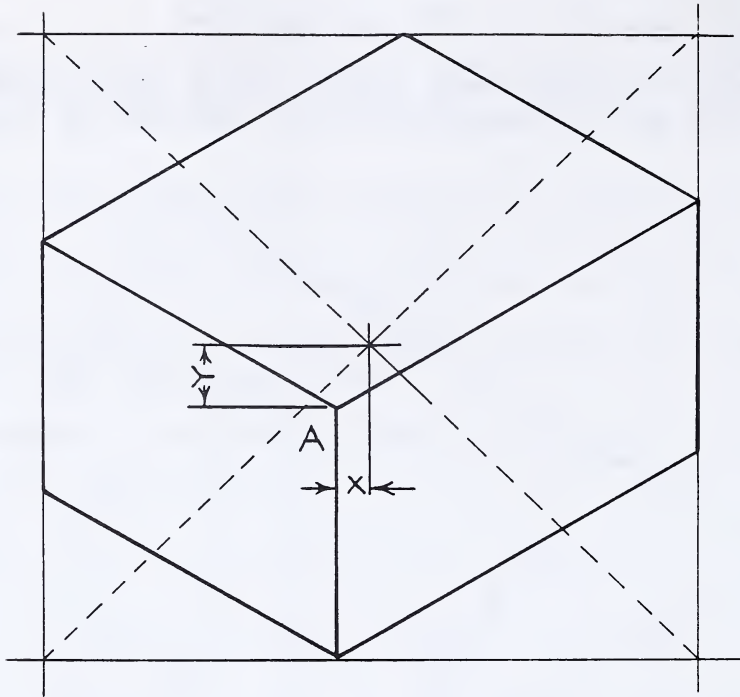
Exercise 2: Isometric and Non-Isometric Lines

Examine the drawing below and pick out all the non-isometric lines on it. Letter an N through each non-isometric line you find, like this: 

The Isometric Box

When an isometric drawing of an object is to be placed on a plate the problem arises as to how to center the drawing on the plate. Since the over-all dimensions of the object are measured on an angle you can not find out from these what the extreme length and width of the drawing will be. To get this information, and as an aid in making the isometric drawing, we use the device of the isometric box.

For example suppose we want to draw an object with over-all dimensions, length 125 mm, width 100 mm, height 75 mm. Start with the front top corner A and locate it on a piece of scrap paper somewhat to the left of and below the center of the paper. Now draw the complete outline of the box TO SCALE with instruments.

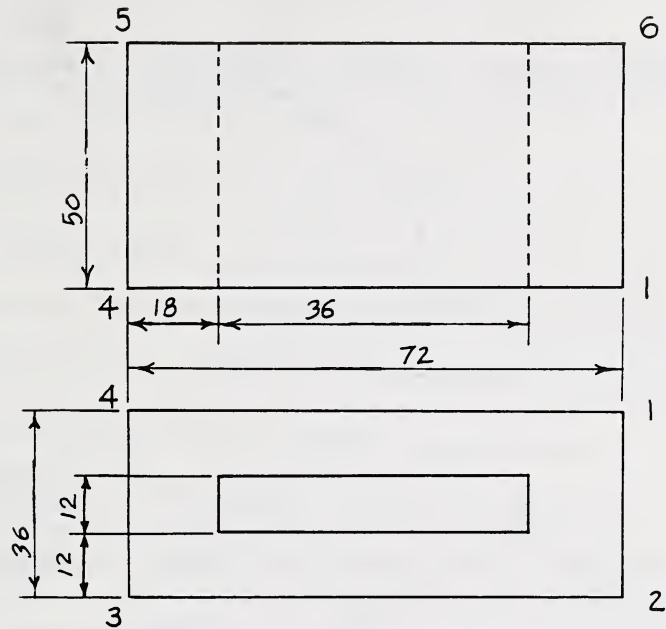


Enclose the isometric box in a rectangle which exactly contains the box. Find the center of this rectangle by locating the point of intersection of its diagonals. Now measure to scale how far A is to the left of, and down from the center of the rectangle. Start your drawing on the plate by locating A these distances from the center of the working space of the plate.

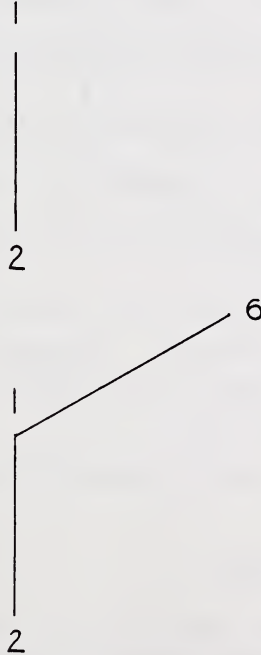
How to Make an Isometric Drawing, Given Orthographic Views

For reference, the corners of the object have been numbered. See page 11. (Note that edge 1-4 shows in both top and front views.)

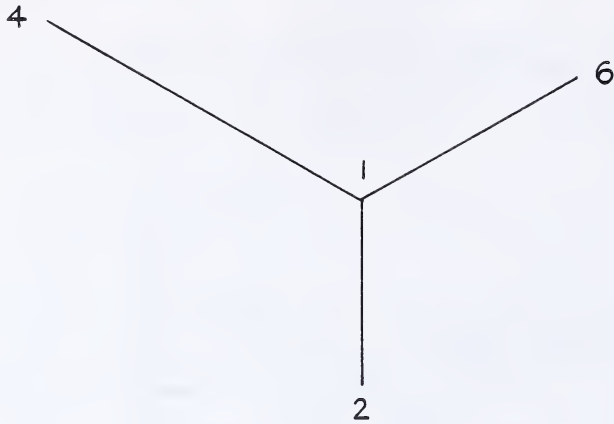
We shall make the isometric drawing with edge 1-2 directly in front of the observer. Use these instructions to enable you to draw the object first on scrap paper to scale, roughing in the main features of the object. Then use the rough drawing to get the measurements required for centering the final drawing on the plate. Attach the scrap paper to your drawing board so that you can get angle and length measurements reasonably accurate.



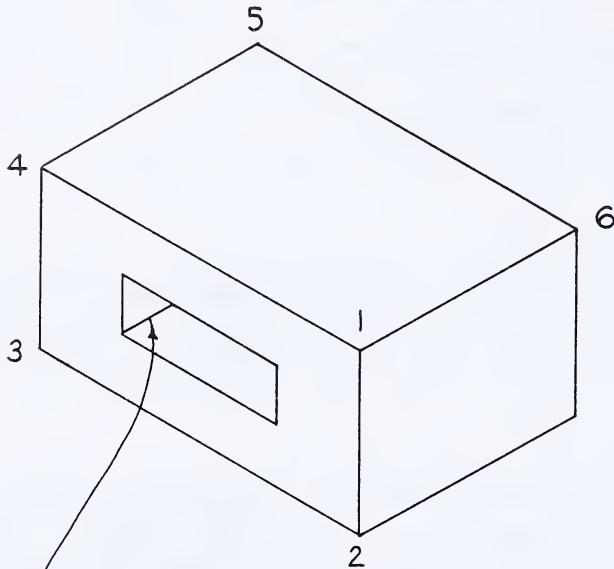
Steps:



1. Draw edge 1-2 to scale slightly to the right of and below the center of your scrap paper.
2. Draw edge 1-6 at 30° using T-square and 30° - 60° triangle. Draw it the correct length to scale.



3. Draw edge 1-4 to scale also at 30° .



4. Complete the isometric box by drawing the remaining edges parallel to those already drawn.

5. Insert the outline of the mortise. Measure the vertical dimensions for the mortise up and down on the paper, and measure the horizontal dimensions along the 30° line.
6. Note that this edge is visible because the observer can see into the interior of the mortise.
7. OMIT ALL HIDDEN EDGES.
8. After the object has been drawn thus on scrap paper, dimensions are inserted and then the whole drawing is measured for centering on the plate.

Exercise 3: Review of Facts about Pictorial Drawings

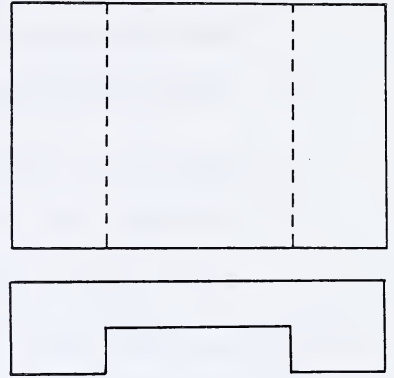
1. Choose from the words Oblique, Cabinet, Cavalier, Isometric, Perspective, Orthographic, the one which applies to each of the following, and write it in the blank.
 1. Has converging lines. _____
 2. Shows hidden edges. _____
 3. Cabinet and Cavalier drawings are each _____
 4. Receding lines are half actual measurement. _____
 5. Has foreshortened vertical lines. _____
 6. Requires a 30°-60° triangle. _____
 7. Has horizontal, vertical, and oblique lines on one of the side views in true length.

 8. Makes the truest picture. _____
 9. Surfaces are equally inclined to the observer. _____
 10. Surfaces are squarely set before the observer. _____
 11. A drawing with three detached views. _____
 12. Box construction very helpful. _____
 13. Involves isometric and nonisometric lines. _____
 14. Object appears longer and deeper than it really is. _____

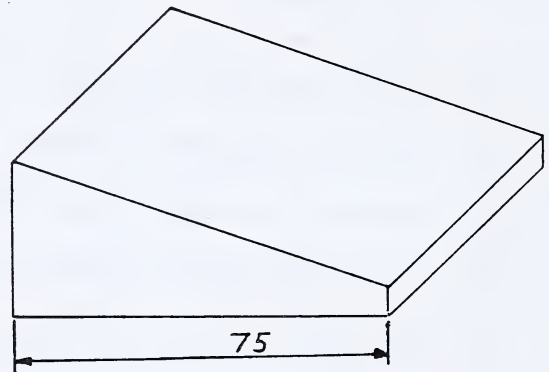
Exercise 4: Problems in Isometric Drawing

For this lesson we shall omit dimensioning on plates. Draw the isometric drawings on the prepared plates. Each drawing should be properly centered on a plate. The record strips should be completed as described earlier in the course.

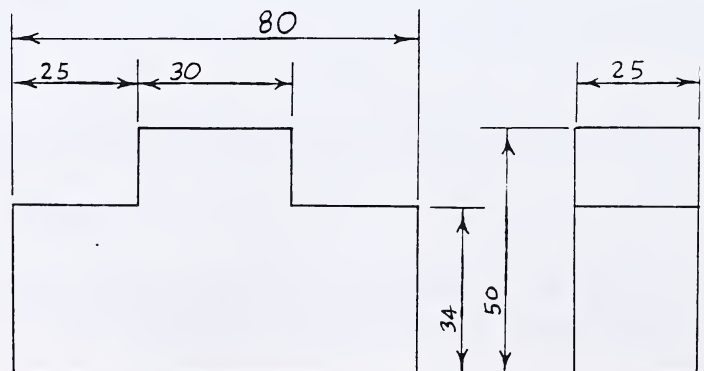
1. Make an Isometric drawing of the Half Lap.
Length, 75 mm
Width, 50 mm
Overall height, 18 mm
Depth of slot, 9 mm
Distance from edge to side of slot, 18 mm
Slot is centered in the length.



2. Make an Isometric drawing of the Wedge.
Length, 75 mm
Width, 43 mm
Height at thick end, 29 mm
Height at thin end, 6 mm



3. Make an Isometric drawing of the T Block from the Orthographic drawing below.

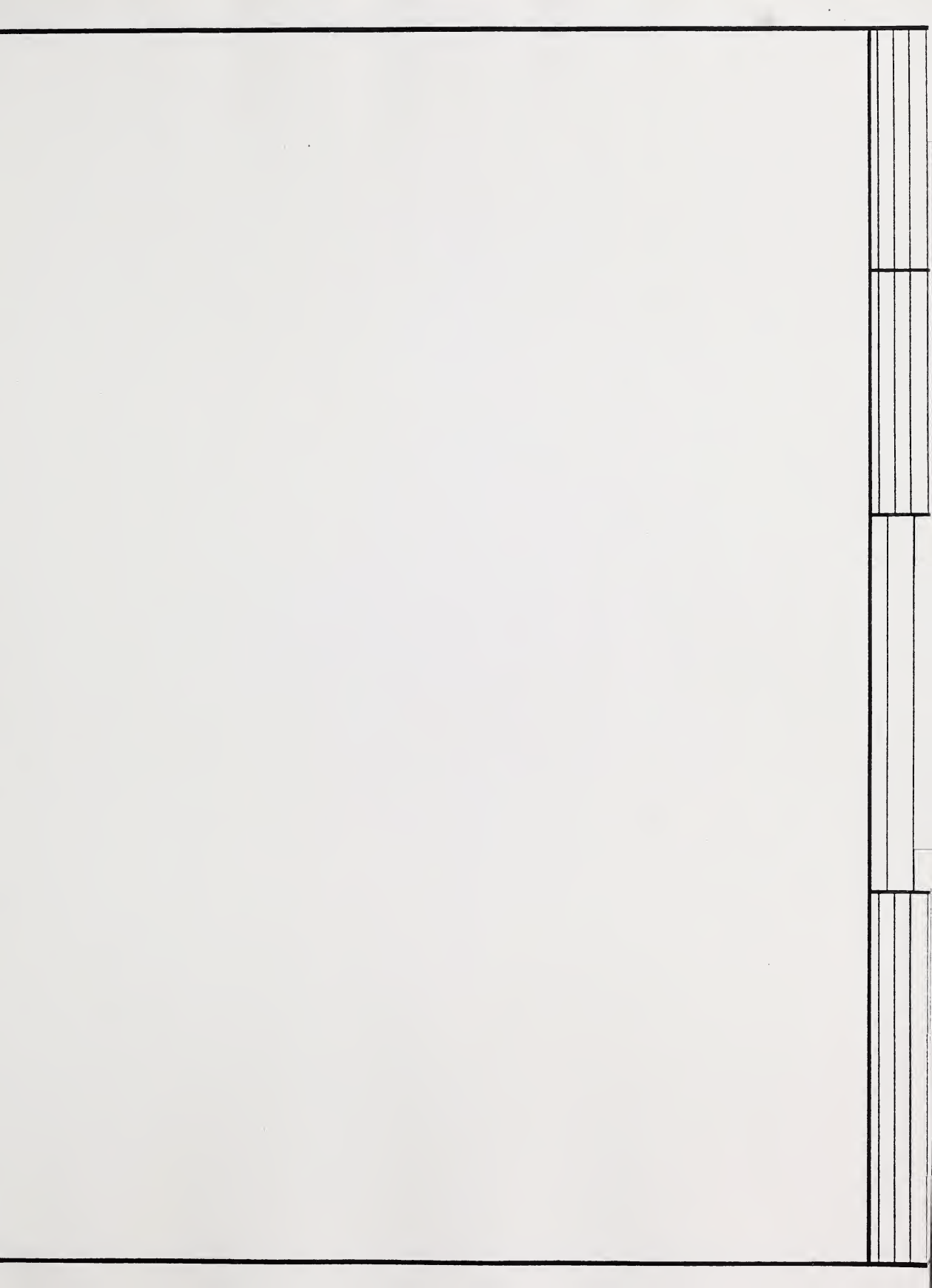


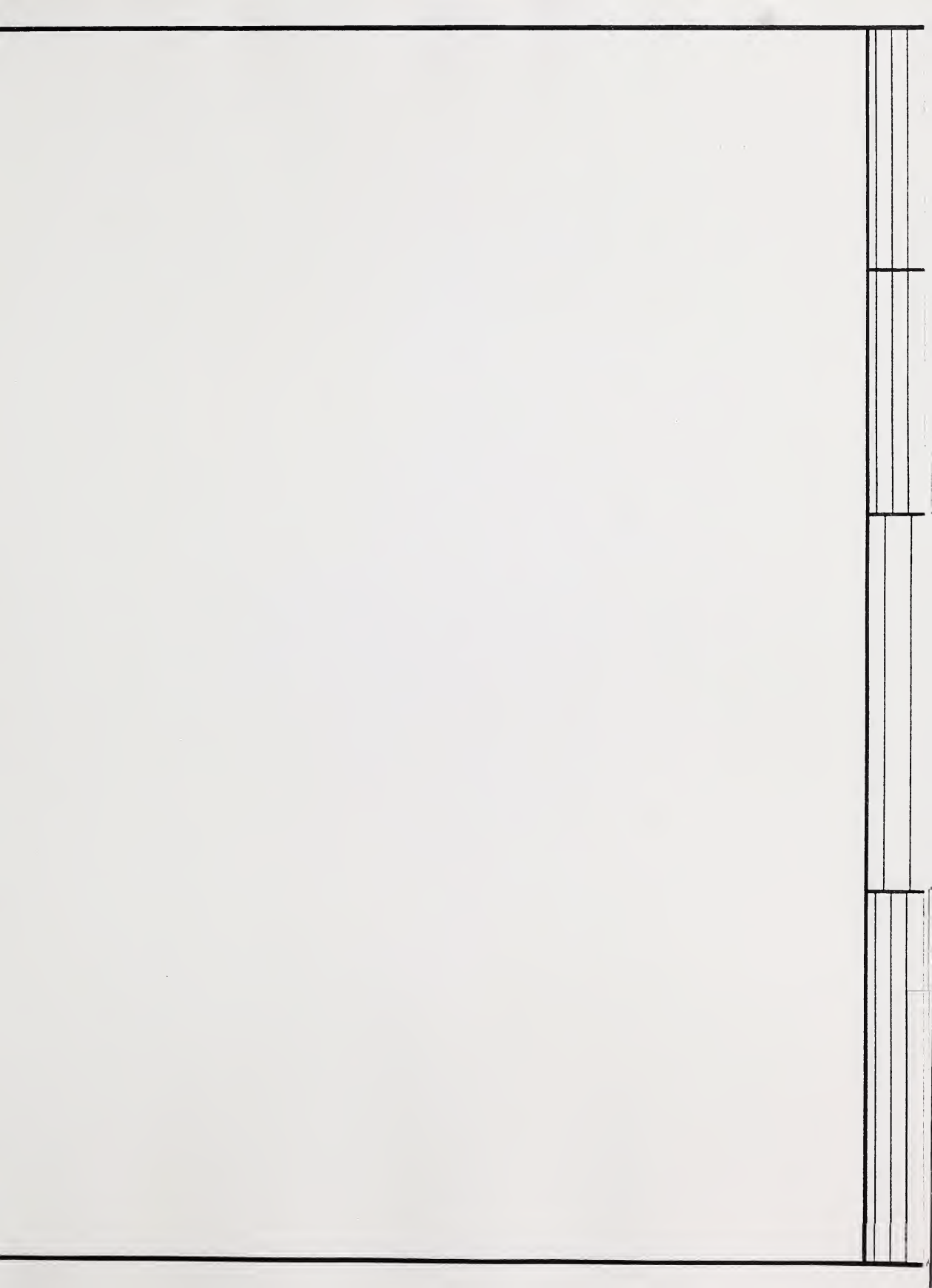
[illegible]

[illegible]

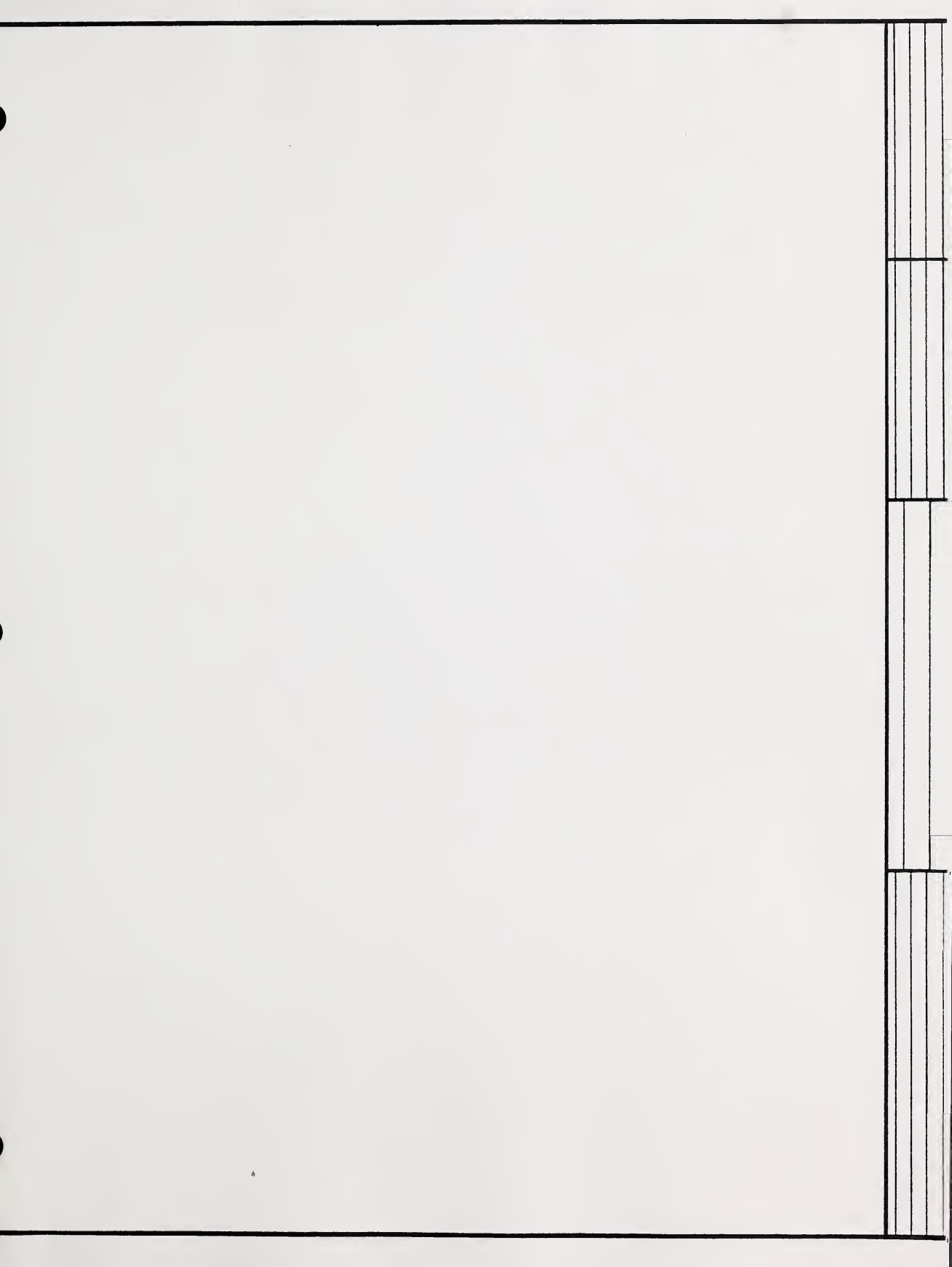
[illegible]

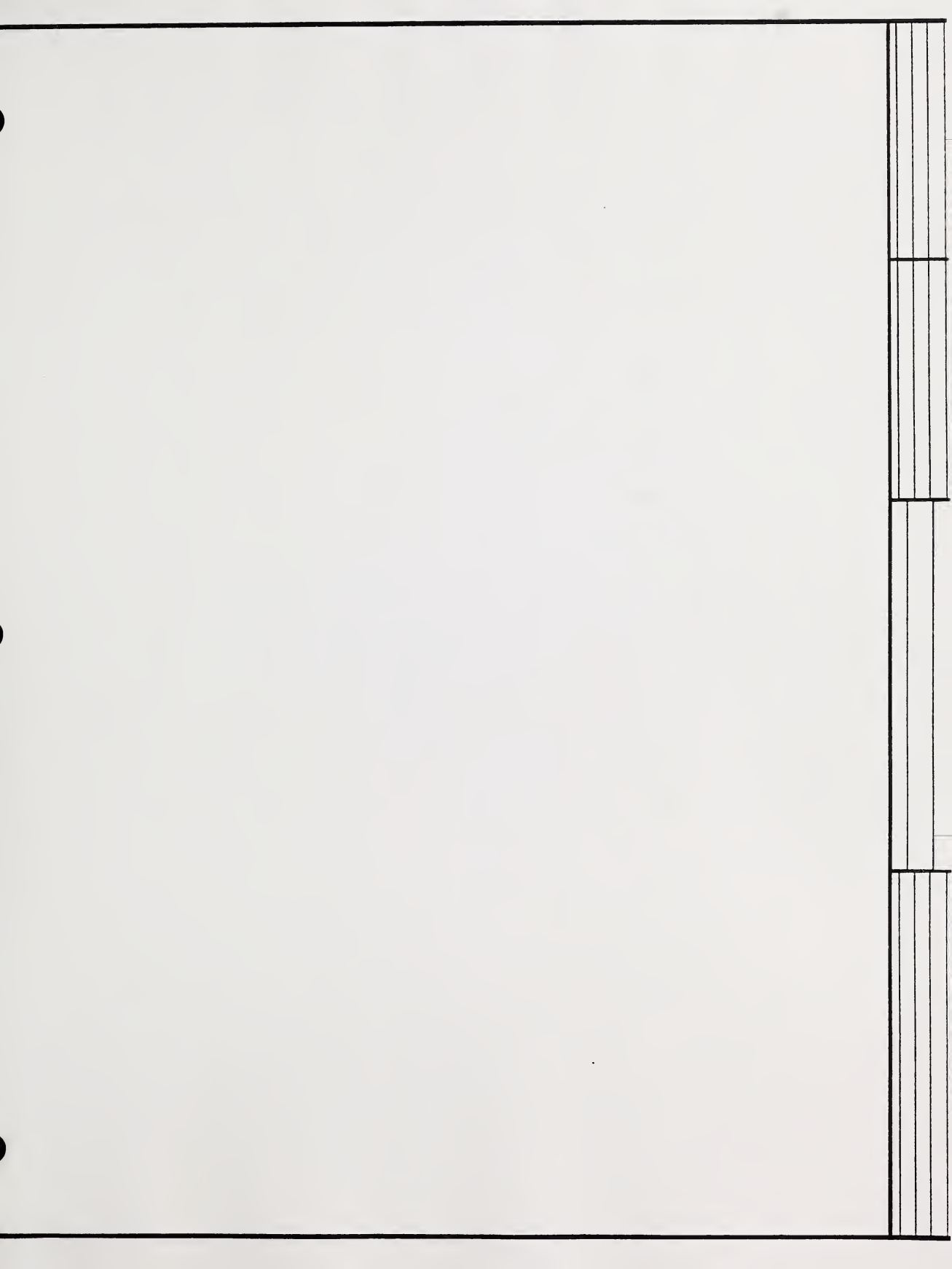
[illegible]

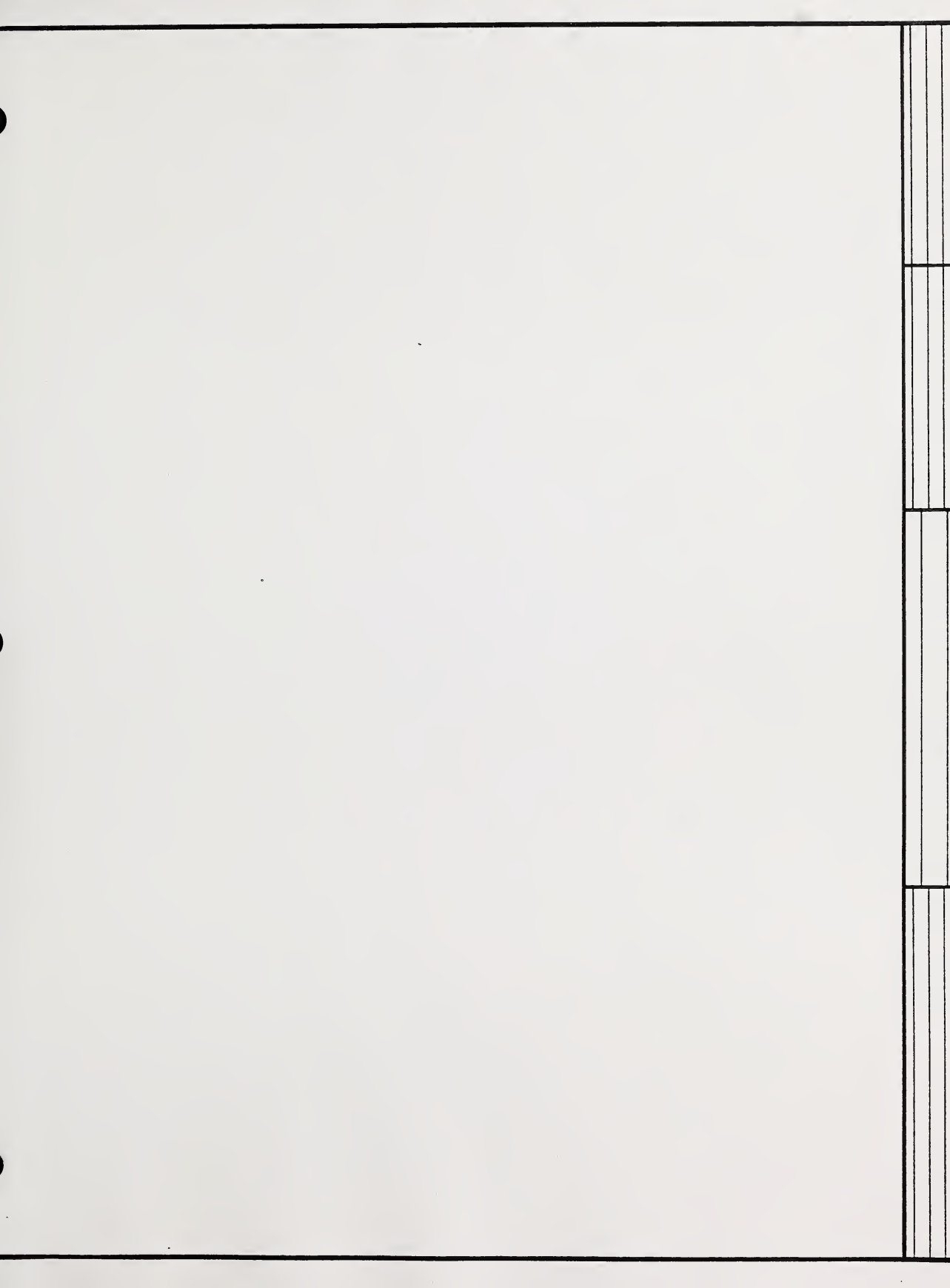




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N.L.C. - B.N.C.



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